The Electrical World.

VOL. XXV. NEW YORK, JUNE 1, 1895. No. 22.

PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY, Limited,

253 Broadway, New York.

Established 1874. Incorporated 1889.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 620 Atlantic Ave., Boston.
Western Office, 936 Monadnock Block, Chicago.
Philadelphia Office, 927 Chestnut Street.

SUBSCRIPTION IN ADVANCE, ONE YEAR, $3.00,

in the United States, Canada or Mexico; other foreign countries, $6

In requesting your address changed give OLD as well as new address.

Now in its third decade, THE ELECTRICAL WORLD is the Pioneer Electrical Journal of America, and has well maintained its lead. It has the Largest Circulation of any electrical periodical, and is the best Advertising Medium.

THE ELECTRICAL WORLD'S Advertising Rates are much lower than those of any other similar publication, circulation considered, and vary according to space, position and number of insertions. Quotations promptly furnished.

Address and make drafts, orders, etc., payable to

THE ELECTRICAL WORLD,

253 Broadway, New York.

VOL. XXV. NEW YORK, JUNE 1, 1895. No. 22.

CONTENTS.

Editorial 625
The American Institute of Electrical Engineers 626
Organization of Telephone Manufacturers 626
Berliner Telephone Patents 627
A Modern English Central Station 629
On A Possible Law of Residual Magnetism in Iron and Steel, by Edwin J. Houston, and A. E. Kennelly 631
Rope Driving.—XVIII., by J. J. Flather 633
Electrodynamic Machinery—XXXVII., by Edwin J. Houston and A. E. Kennelly 635
A Peculiar Phenomenon, by M. A. Veeder 637
Digest of Current Technical Electrical Literature, compiled by Carl Hering 638
New Book 643
A Five-Volt Multiple Battery 643
A Regulating Lamp Socket 643
DEPARTMENTS:
Financial Intelligence 644
Special Correspondence 644
General News of the Week 645
Trade and Industrial Notes 647
Business Notices 647
Illustrated Record of Electrical Patents 647

ELECTRICAL INSTALLATION RULES.

The English Institution of Electrical Engineers having announced that it proposes to issue a set of rules for interior electrical installations, Mr. Musgrave Heaphy, the underwriters' expert, informs the public through the London *Electrician* that his company will not for one moment recognize such a foreign code. In view of the desire of some members of our Institute to commit that body to a similar measure, the reasons advanced by Mr. Heaphy on the subject are of interest at the present moment, and also worthy of serious consideration. These reasons are very brief, namely, that his company "has the responsibility of paying for fire losses, and, therefore, it is "absurd to think that it would agree to anything that might practi- "cally place the disposal of its funds at the mercy of the views of "an outside body," and it will therefore "not depart from the "course that long experience has proved to be so safe, and will "require as before that in any building insured with it the electrical "work shall comply with its rules." That this position is a reasonable one cannot, we believe, be contested, and the only result of the Institution rules will probably be to further strain the relations of underwriters' experts and electrical contractors. Instead of formulating an entire code of rules, the influence of such a professional body should, we believe, be directed toward inducing the underwriters to change such of their rules as are really objectionable. In this it would probably be finally successful, for we doubt if the insurance interests would care to defy such authority. There is, however, no prospect whatever that they would ever discard their own rules for those of an outside body, which latter code would therefore have no other effect than to accentuate the differences between two interests naturally antagonistic.

THE BERLINER TELEPHONE PATENTS.

In another column we print an account of all of the Berliner telephone patents issued prior to 1882, from which it appears that of eight granted within that period, four are now in force in this country and four have expired with the French and Belgium patents on the same inventions, the latter patents being identical with the English one to the same inventor, dated Jan. 8, 1880. It will be noted that none of these Berliner patents is of any apparent practical value, and the same may be said of that issued in 1891, which assumes a great importance merely from its claim of the variable-pressure, constant-contact principle. In the same article will be found the dates determining the priority of Berliner over Edison in the invention of the microphone, from which it will be seen that the interval was one of but a few months, and that Edison had grounds in his application of April 27 on which to claim the microphonic principle for which Berliner filed an application on June 20 of the same year. In this connection it is well to remember that the Bell Company in 1878 and 1879 bought both the Berliner and Edison claims for patents, and, therefore, the incentive was lacking which otherwise would have brought about a hard-fought contest for priority. The relation of the Berliner patent to the Edison, Blake and Hunnings patents does not seem to be very well understood, if we are to judge from our correspondence. If the Berliner 1891 patent is valid, it covers the fundamental principle upon which the latter rest for their action—that of producing the undulatory telephonic current by a constant contact subjected to variable pressure by the vibrations of a telephone diaphragm. While the Bell patents were in force, the Berliner principle was tributary to it as far as related to the transmission of speech by the undulatory current, and the other patents named were tributary to both the Bell and Berliner. The principal Edison patent—issued in 1892 and expired on account of the expiration of a corresponding foreign patent—covers the use of carbon in the application of the Berliner principle, and thus ranks after both the Bell and Berliner patents. The Hun-

nings patent covers the use of granulated carbon, and therefore is secondary to the Edison patent, which is also true of the Blake patent, the latter covering certain mechanical telephonic devices, and not the employment of carbon. For the first of the two earliest Berliner patents now in force—that of Dec. 14, 1880—the claim is made that it covers the use of the induction coil, but the patent refers to an entirely different method of using that device than has ever been employed, the claims being for a battery in two independent primaries, one including the receiver and the other the transmitter circuit, the secondary of the induction coil being stated to act on the *current* in the transmitter circuit. In our last issue we inadvertently stated that the Nov. 2, 1880, patent had expired, which is an error. However, even should the 1891 patent be declared void on account of the fourth claim of the earlier patent involving also the transmitter, the Nov. 2, 1880, patent will have no effect, as its direct claims are confined to a form of receiver that has no practical value whatever.

STEAM JACKETS AND SUPERHEATING.

Prof. Unwin, in a recent lecture before the English Institution of Civil Engineers, expresses the opinion that little or no economy is to be derived from the use of steam jackets on well-designed engines, though they may increase the efficiency of poorly designed or small engines. The subject of steam jackets has been one upon which the widest differences of opinion have existed, but the verdict of Prof. Unwin is in accordance with the results of the latest and most carefully conducted trials. In the same lecture the advantages of superheating are strongly brought forward, the statement being made that no possible improvement of the steam engine of which we have any knowledge at this moment, offers anything like so great a chance of important economy. This claim does not relate to a rise of but a few degrees in temperature, as was the practice 25 years or more ago when superheating met with considerable favor, but refers to an elevation of 100 degrees or more above the temperature of saturation. Some experiments are quoted in which the temperature was carried to 670 degrees, or over 300 degrees above the saturation point; with a pressure of 165 pounds of steam and a piston speed of but 380 feet, the consumption of steam in this case was but 10.2 lbs. of water per indicated horse-power. The reason why superheating was abandoned in the early days notwithstanding the economy it had demonstrated, was largely on account of the practical difficulties met with in the superheating apparatus and in the lubrication of the engine cylinders. As these difficulties have now been largely overcome, the fact that superheating had once been tried and practically found wanting has no longer any bearing, and any objections to its utilization at the present day can rest on no other grounds than prejudice—which, however, is an extremely potent factor among steam engineers.

ORGANIZATION OF TELEPHONE MANUFACTURERS.

As noted in another column, a movement is under way to organize an association of the telephone manufacturers of the United States with a view to the protection of their mutual interests. Such an association can be productive of much good in many directions, and particularly with respect to the determination of the value and status of the numerous telephone patents now owned or controlled by the Bell Company. In the brief of that company in the Berliner case these are stated to number 934, or almost one third of the entire number granted on improvements in telephones and in apparatus to be used in connection with telephones. Owing to the complete monopoly of the Bell Company during a long period of years, there was little or no interest for any one outside of that company to keep track of the course of telephone invention, and the consequence is that knowledge at present in regard to the scope and status of telephone patents is extremely limited. This is particularly true with respect to switchboard patents and those dealing with details of exchange equipment and with telephonic accessory apparatus. When the several suits now pending involving the above features are tried, some points may be cleared up, but this process will take a long time, and what is needed is immediate information. Owing to the extremely large number of patents, the necessity of also examining all foreign patents and the complexity of the legal and other points involved, a proper consideration of the subject will require the best expert and legal services, and an expenditure of money that would be probably greater than any individual firm would feel justified in assuming. We would therefore, suggest that one of the objects of the proposed association be the undertaking of the work referred to, thereby placing its members in a situation to intelligently direct their efforts instead of, as at present, having frequently, to grope in the dark.

The American Institute of Electrical Engineers.

The annual meeting of the Institute for the reception of the yearly reports and election of officers was held at 12 West 31st Street May 21. The Council reported a membership of 944, showing a net gain of 144 members for the year ending April 30, 1895.

The chair then announced that the discussion of Prof. Anthony's paper on "Underwriters' Rules" would be taken up, and called upon Prof. W. L. Puffer, of the Massachusetts Institute of Technology, to open the discussion, which he did by the presentation of some interesting data that had been obtained from tests made for the Mutual Insurance interests of Boston, showing the amount of current required in a given wire to cause the insulation to deteriorate, and that which would make it smoke.

At the conclusion of Prof. Puffer's remarks Prof. Anthony said that he was very glad he had presented his paper if it had been the means of having such valuable information brought before the Institute. It was the general sense of the majority present that the Institute should not attempt the formulation of any rules, but that a conference between committees from this body and the underwriters would no doubt be productive of benefit all around.

The count of letter ballots, which was not completed until midnight, gave the following result:

FOR PRESIDENT.

Dr. Louis Duncan, of Baltimore, Md.

FOR VICE PRESIDENTS.

Dr. Michael I. Pupin, of New York City.
W. F. C. Hasson, of San Francisco, Cal.
Angus S. Hibbard, of Chicago, Ill.

FOR MANAGERS.

Carl Hering, of Philadelphia, Pa.
Bion J. Arnold, of Chicago, Ill.
Charles F. Scott, of Pittsburgh, Pa.
Dr. Cary T. Hutchinson, of New York City.

FOR TREASURER.

George A. Hamilton, of New York City.

Organization of Telephone Manufacturers.

A movement has been started contemplating the organization of an association including all of the telephone manufacturers of the United States except the Bell Company. To this end Mr. J. E. Keelyn, of Chicago, has addressed a letter to the various companies calling a meeting in Chicago on June 1. It is urged that the probable effect as to the form of order to be entered by the United States Court of Appeals in the Berliner case at Boston, requires the earnest and urgent attention of all those expecting to be engaged in the manufacture or production of telephone apparatus. The further necessity for preparing for the promised onslaught of the Bell people, it is stated, also calls for immediate organization toward a peaceful conduct of legitimate telephone business, and the maintenance of the legal and business rights of those engaged in it.

Salaries of Electrical Engineers.

Without entering upon the debatable region of ethics, says the London *Electrician*, it is quite possible to argue, on the ground of bare expediency, that the low salaries of electrical engineers, which until lately were universal, and still remain the rule, are a mistake. Men tantalized by such doles naturally become mere birds of passage, ready to take flight to fresh fields and pastures new for the smallest increment of pay.

Berliner Telephone Patents.

As but little appears to be known of the earlier Berliner telephone patents, we give below an account of these issued prior to 1882. In order, however, that the bearing of these patents may be clearly understood, it is necessary first to take a glance at the history of the 1891 patent, which contains the fundamental claim, the others issued claiming only invention of details.

On April 14, 1877, Berliner filed a caveat describing the variable-pressure constant-contact transmitter. On April 27 Edison made

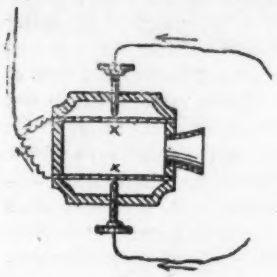


FIG. 1.

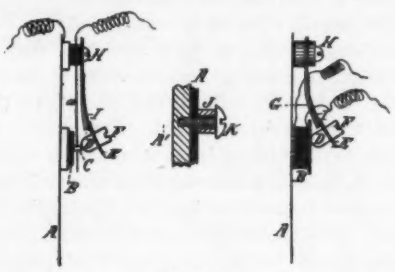


FIG. 4.

application for a patent on a transmitter in which an electrode presenting a considerable surface and coated with plumbago is in contact with the diagram, but did not make any claim for the principle of variable pressure and constant contact which was partly involved in its operation; patent No. 474,230, issued in 1892, is based on this application. On June 4, 1877, Berliner filed his application for a patent on the invention described in the caveat of April, which patent was finally granted in 1891 On July 20, Edison filed an application covering broadly the use of carbon as a material for the electrode contact in a transmitter operating by variable pressure and constant contact, which resulted in patent No. 474,231 of 1892. In March, 1878, interference proceedings relating to the Berliner patent were begun in the Patent Office and ended in 1882; from 1882 to 1888, the patent was withheld on account of Drawbaugh's claims and suits; in 1888 the Patent Office rejected the application of Berliner on the ground that his original application was bad, and because of intermediate patents, but in 1889 reversed this decision; the next two years were spent in public use proceedings in connection with Drawbaugh's claims, and awaiting the final decision of the Supreme Court in the Drawbaugh case, the patent being finally issued Nov. 17, 1891.

While the application of Berliner involving the fundamental principle of the microphone was thus tied up, the inventor applied for and obtained a number of patents on telephones, the first of which was issued Jan. 15, 1878 (No. 199,141, reissued as No. 9,499 Dec. 14, 1880), on an application dated Oct. 16, 1877, the preamble of the patent referring to the application of June 4, 1877, as containing the principle of transmitting speech by the microphonic principle. The patent is for a receiving instrument consisting of several metal or carbon electrodes in contact with a metal

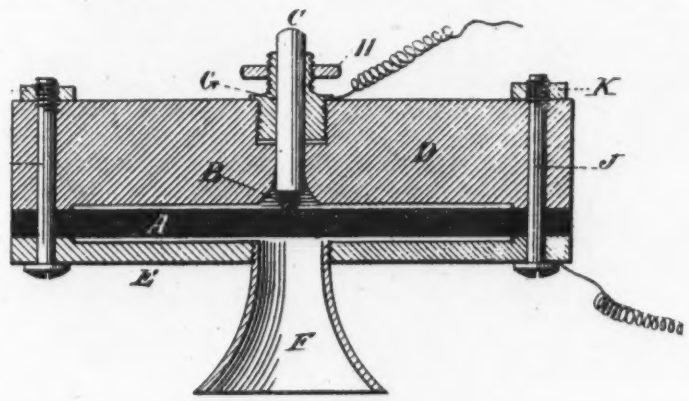


FIG. 2.

or carbon diaphragm, or of two diaphragms (Fig. 1), each having a single electrode in contact. Also, for a telephonic relay consisting of two cores of iron, one coil of each forming a common closed circuit, and the other coil of each being in the transmitting and receiving circuit, respectively, each circuit containing a primary battery. In the specifications it is claimed that by this means the transmitting current in the coil will, by means of the action of the common coil, affect the *current* in the receiving circuit so as to increase its action on the receiving instrument. Claim 1 is on several electrode pins and a single diaphragm, and Claim 2 for two plates with a single electrode for each; Claim 3 is for the induction apparatus with two separate battery circuits and a common closed secondary; Claim 4 is on a method of transforming telephonic currents by permitting them to act by induction on a continued galvanic current acting on the receiver; Claim 5 is on a receiver situated in the second galvanic circuit, in which undulations are produced by the inductive undulatory currents of another circuit. This patent was reissued Dec. 14, 1880, on an application filed Oct. 23, of the same year, a disclaimer being added for an induction coil that interrupts the current, and two additional claims added; one of these is for the combination of a transmitter, local battery, a short primary circuit of induction coil, and a secondary circuit proceeding toward the distant station; the other claim is for a grounded tertiary circuit of the coil.

The second Berliner patent (No. 222,652) was granted Dec. 16, 1879, on an application filed Aug. 11, 1879, and relates to a carbon telephone and a method of preparing and hardening the carbon electrode. The claims referring to the instrument (Fig. 2) are four in number and relate to the electrode, which may rest by its weight on the diaphragm, or be clamped in position. The fifth claim is on the process of manufacture of the carbon electrode.

Patent No. 224,573, dated Feb. 17, 1880 (application filed Sep. 5, 1879), is on methods of dispensing with the clamping device for the carbon electrode referred to above, and maintaining the electrode constantly in contact with the diaphragm by the

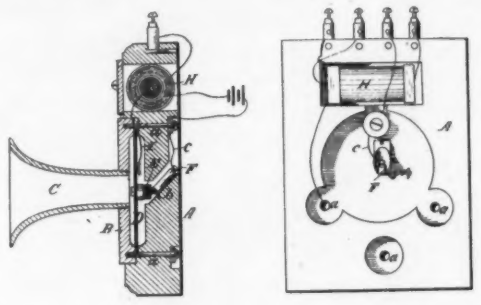


FIG. 3.

action of gravity, and in connecting the electrode to the battery by a device that will not interfere with its action. Fig. 3 reproduces the illustrations accompanying the specifications. The first claim is for a gravity electrode and connection to battery so as not to interfere with its action, and the four other claims on the details of the device shown.

Patent No. 225,790, dated March 23, 1880 (application filed Nov. 12, 1879), is on methods of keeping the carbon electrode in contact with the diaphragm by means of a pendulous weight suspended by a band or ribbon of some flexible material, as shown in Fig. 4. The seven claims relate merely to details of the devices shown.

The next patent in order of date is the celebrated one of Nov. 2, 1880, which will be taken up for consideration later.

Patent No. 234,744, dated Nov. 23, 1880 (application filed March 31, 1880), covers various details relating to the device described in No. 225,790, consisting of an adjusting device whereby the angle of the pendulous weight may be varied, of a damper attached to the diaphragm and acting on the carbon electrode and a method of suspending the pendulous weight from a magnet which holds the weight by attraction. Four claims cover the above points and a fifth covers electroplating the magnet on its face of contact.

Patents Nos. 222,652, 224,575, 225,790 and 234,744 were combined in one patent granted in England, France and Belgium, while an endorsement on the last-named United States patent shows that it was also taken out in Italy on Feb. 15, 1880. The English patent was applied for Jan. 8, 1880, and sealed April 16, 1880, but the specifications, drawings and claims were not filed until July 7, 1880. The French patent was granted Jan. 8, 1880, and the

Belgium patent Jan. 9, 1880, and have therefore expired, thus voiding the four United States patents. The above British patent (No. 91) is the only one issued to Berliner in that country previous to 1882.

Patent No. 241,912, dated May 24, 1881 (application filed Dec. 22, 1879), is an improvement relating to that class of telephones in which one electrode is held in position by being attached to a spring, and consists in an improved manner of adjusting the tension of the spring by a second spring, and the five claims refer to various combinations of the two springs.

Patent No. 248,839, dated Nov. 1, 1881 (application filed July 30, 1881), contains two claims, one on electrodes in an air-tight box in which there is a vacuum, and the other on the particular arrangement of the carbon electrode.

The above are all of the patents granted to Berliner previous to 1882, and of these none is of any practical importance and only one —that of Nov. 2, 1880—has any bearing on the Berliner case. The latter is on a form of receiver that has never been used and the others relate merely to details that have had no practical application.

The importance of the patent of Nov. 2, 1880 (No. 233,969, and for which application was made Sept. 3, 1880), comes from the construction placed by the government counsel in the Berliner suit on the fourth and final claim, the other three claims being

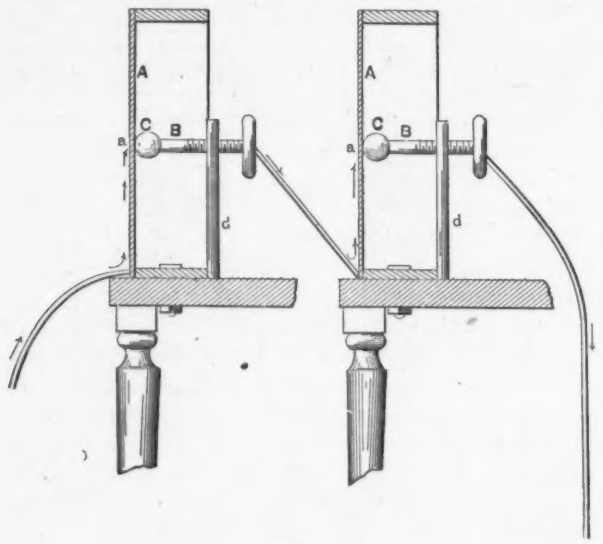


FIG. 5.

conceded as relating to the particular receiver shown in the patent. This claim reads as follows: "A system of two or more telephone instruments in electrical connection with each other, each consisting of two or more poles of an electrical circuit in contact one with another, either or both poles of each instrument being connected with a vibratory plate, so that any vibration which is made at one contact is reproduced at the other, substantially as set forth."

Fig. 5 is a reproduction of the drawing of the patent of Nov. 2, 1880, which is the same as one in the patent of 1891. The following are the claims of the latter patent upon which its great value depends:

"1. The method of producing in a circuit electrical undulations similar in form to sound waves by causing the sound waves to vary the pressure between electrodes in constant contact, so as to strengthen and weaken the contact, and thereby increase and diminish the resistance of the circuit, substantially as described.

"2. An electric speaking telephone transmitter operated by sound waves and consisting of a plate sensitive to said sound waves, electrodes in constant contact with each other, and forming part of a circuit which includes a battery or other source of electric energy, and adapted to increase and decrease the resistance of the electric circuit by the variation in pressure between them caused by the vibrational movement of said sensitive plate.

"3. The combination, with the diaphragm and vibratory electrode, of a rigidly held opposing electrode in constant contact with the vibratory electrode, substantially as described.

"6. A speaking telephone transmitter comprising a diaphragm or disc sensitive to sound waves, combined with a rigidly held but adjustable electrode in contact with the same, whereby the electric current is transformed into a series of undulations corresponding with the vibrations of said diaphragm."

The government in the recent suit held that the divisional patent of Nov. 2, 1880, describes the whole invention of the microphone exactly as it is described in the patent of 1891, and claims it as so described, but only when used in association as a receiver; that the patent of 1891 adds nothing to the description of the invention, and nothing to the claim of it except to broaden the scope of the claim by omitting the limitation of association with the microphone receiver; and that the case therefore falls under the principle that two patents cannot be granted for one and the same invention. It covers the described microphone receiver and the described microphone transmitter, each constructed just like the other, set up at opposite ends of the line, and provided with suitable speaking and hearing tubes, so that either may act as a receiver or a transmitter, according as the talking is done at one end of the line or the other. The Berliner Claim 4, of 1880, it was maintained, is not for the combination of microphone transmitter and microphone receiver, as there is no transmitter which is not a receiver, and no receiver which is not also a transmitter; therefore, there is no distinctive transmitter and no distinctive receiver, and the case does not come under the law of combination. "The patent describes, and Claim 4 covers, a duplex telephone having a microphone transmitter and a microphone receiver at each end of the line. Such a patent might exist as junior to a patent for the microphone transmitter; but a patent for a microphone transmitter cannot validly exist as junior toit." It was argued by the government counsel that in his first patent Berliner had claimed his microphone when it was also a microphone receiver, and that in the second patent he claimed his microphone transmitter whether it was also a microphone receiver or not.

Judge Carpenter held that the 1880 patent was for a system or combination of a transmitter and a receiver for a speaking telephone. "The whole apparatus is shown in the drawings of both patents and is identically the same in both. The transmitter and the receiver are identical in form and differ in function according as they are placed at the transmitting or at the receiving end of the telephone wire. It, therefore, appears that one of the functions of the device shown in the patent of 1880, namely, the function of transmitting articulate speech, is identical with the sole object or function of the device covered by the patent of 1891, and that the device for effecting the transmission is identical in both patents. The patent, therefore, seems to me to be void and beyond the power of the commissioner to issue."

The counsel for the Bell Company argued, on the other hand, that in January, 1877, Berliner "invented a new transmitter, and when this is put in place of Bell's transmitter the complete apparatus, still using Bell's receiver, will transmit speech. He was *then* entitled to a patent for that transmitter. His 1891 patent is patent for exactly what he then did and for nothing else. In April, 1877, he invented a new receiver. When this is put in place of Bell's receiver, either in the complete apparatus Bell made, or in the complete apparatus Berliner himself used in January, speech will be transmitted. He *now* became entitled to a patent for exactly the difference between what he had done in January and what he had done in April. His 1880 patent is for that and for nothing else. All that Berliner did or knew how to do in January may be done without infringing the 1880 patent, unless there be *also* used the receiver, which Berliner did not conceive of until April."

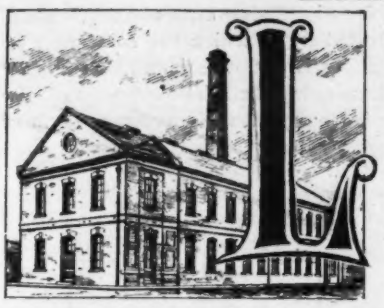
It was contended that the transmitter and receiver were totally distinct inventions; that neither invention lies in the structure, each consisting in the new mode of operation by which the respective functions of each is performed. "The functions of the two are different in kind; the results are different in kind; and the respective modes of operation are utterly different in kind and have nothing in common."

It may be added that had the 1891 patent remained void, the Bell Company could not have claimed any protection under the 1880 patent (which expires in 1897) except against the unauthorized use of the instrument there described as a receiver.

A Good Example for Brooklynites.

A Jersey City newsboy recently found himself in front of a rapidly moving trolley car without an opportunity to get off the track. Instead of waiting to be knocked down he jumped into the fender, and when the car stopped, hopped out unhurt and proceeded to sell his papers. Citizens of Brooklyn might practice the time-honored art of "jumping the rope" in their back yards on Sundays so as to profit by this youngster's example when the emergency arises.

A Modern English Central Station.



LEICESTER, England, is one of the latest of the English municipalities to establish an electric lighting plant, and the success of its plans is largely due to the sensible policy pursued in leaving the whole of the technical and engineering work in the hands of one capable engineer. Mr. Alfred Colson, the company's engineer, having had a large general engineering experience, was thoroughly posted as to the best practice in steam production, etc., and in order to be fully informed as to the latest methods and results in the electrical branch of the work, visited all the largest and most modern plants in Europe. As a result of the studies made, he determined to adopt a type of direct-connected alternating current unit somewhat similar to those which were seen at the Columbian Exposition in Chicago, namely, a horizontal engine with Corliss valve gear, having the rotating element of the alternator coupled to the shaft so as to act as a flywheel.

The points had in view when the plant was built were: (1) As nearly perfect safety as science could possibly provide; (2) the generating station to be so located as to avoid being a source of great annoyance to residents; (3) the system to be flexible and easy of extension without unreasonable or unprofitable expenditure; (4) the distributing system to be designed and installed in such wise as to avoid as far as possible all interference with the streets, both during original construction and in the event of making repairs; (5) all machinery, apparatus and appliances to be of known reliability, beyond the experimental stage, and of the character best suited for the work to be performed. The plan adopted, after due deliberation, was to generate high-tension alternating currents at a station a mile and a half from town and use underground transformer substations to supply a network of distributing mains at low voltage.

The boiler house is behind the main building, containing the dynamo room and offices, and contains four Babcock & Wilcox boilers, divided into two sets. Each boiler is of 125 hp. Coke is used for fuel, and is obtained from the gas works near by. There is also the regulation equipment of pumps and feed-water heaters.

The dynamo room, a partial view of which is shown in Fig. 1, (which, with the other illustrations, is reproduced from English contemporaries, to whom we are also indebted for the data herein contained), is 40 feet wide, 114 feet long and 31 feet high. It is lighted with a double tier of windows on one end and both sides, except where the boiler rooms abut it. Contrary to the latest American practice the roof has pine rafters and purlins, filled in with diagonal tongue-and-groove panels. The floor is formed of cement concrete poured in between steel joists and paved with tessellated tiling.

A 15-ton electric crane travels the full length of the dynamo room. Three Brush motors, of 4 hp each, series-wound, are used on the crane, and transmit motion to the drums, etc., by means of worm gears. The worm shafts have roller thrust bearings, and the gears run in oil. The motors are direct-current machines and are supplied from the exciter dynamos.

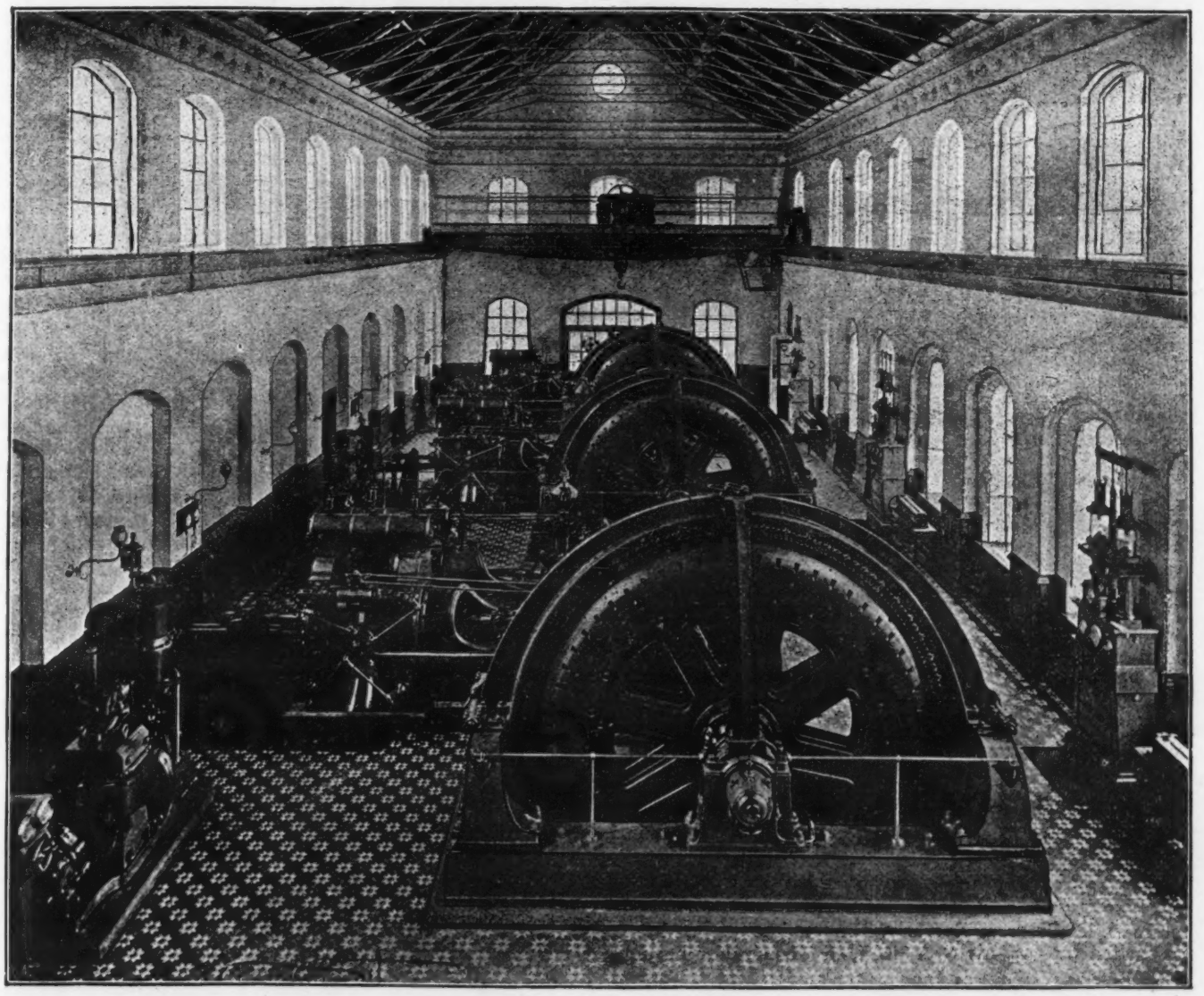


FIG. 1.—VIEW OF DYNAMO AND ENGINE ROOM.

The generating plant comprises three horizontal cross-compound condensing engines of 300 hp each, driving Mordey-Victoria alternators of 200 kw capacity, each unit being direct-connected. Corliss valve gear is used, and the governor controls the valve gear

of both cylinders. Each engine has an individual jet condenser and drives its air pump from a rocker arm attached to the back end of the low-pressure piston rod. In addition to these three large units there is a 75-kw alternator direct-driven by a 112-hp engine, which latter is in every respect similar to the large ones, except that the governor handles only the valve gear of the high-pressure cylinder.

All the cylinders are built up of four castings, an outer shell, a lining shell, and two valve chambers at the ends. Cylinder jackets are provided through which the live steam passes on its way to the valve chambers, and the receiver between the high and low pressure cylinders is similarly jacketed, the steam in its jacket having the full boiler pressure. The valve gear gives unusually rapid opening and a great range of cut-off — from nothing to three-quarter stroke.

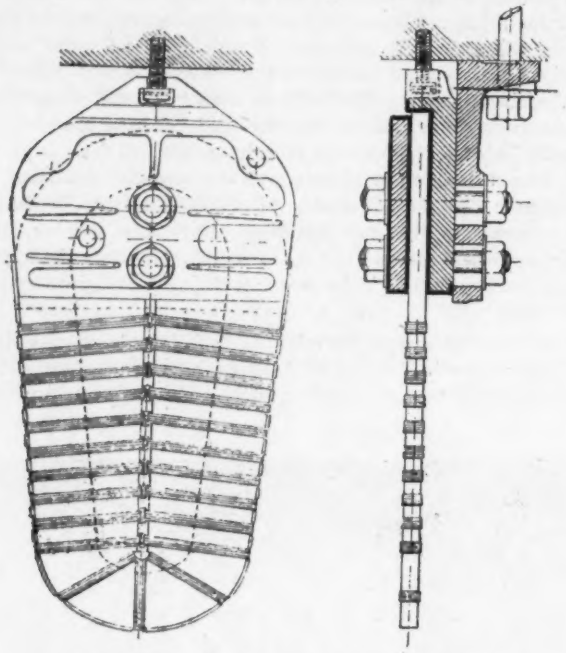


Fig. 2.—Detail of Armature Coil.

The alternators, as previously stated, are of the Mordey type, direct-driven, the field magnets being connected up by means of Raworth flexible couplings. The magnets are massive steel castings, with 60 polar projections on each side of the armature, and are most accurately balanced. There is only a single field coil, as usual in this form of machine. The energy required for excitation is stated as being 2.16 per cent of the output of the machine, which is low for such a slow speed generator.

The armature is of the familiar Mordey type, generally speaking, but there are some interesting details worthy of special attention. In the 200-kw machine there are 120 armature coils mounted on a non-magnetic metal ring, which is bolted to a cast-iron frame made in four sections. Two of the iron quadrants are above the floor, and are hinged at their lower extremities so that either or both can be thrown back for the inspection, *in situ*, of the armature or the removal and replacement of coils. Fig. 2 shows one of the armature coils. A radial adjustment is provided by which the coils may be tightened until they touch one another, but it is found that mutual support is not necessary with these new coils. The supports of the coil are of German silver, ebonized over all the necessary surfaces for purposes of insulation. The coil and its clamps are self-contained, and may be removed from the armature ring simply by slackening the two nuts at the back of the ring. The core is of slate, and has a series of holes down the centre line. After the copper conductor has been wound on and a sheet of anti-sparking material placed over it, pressure is applied, and then the whole is bound tightly together by whipcord threaded through these holes in the core. In this way the slack usually taken up after running is removed before the coils leave the shops. The alternators at Leicester were not erected or tested at the factory and since erecting in the station the armature coils have not given the slightest trouble, neither have they needed any subsequent adjustment.

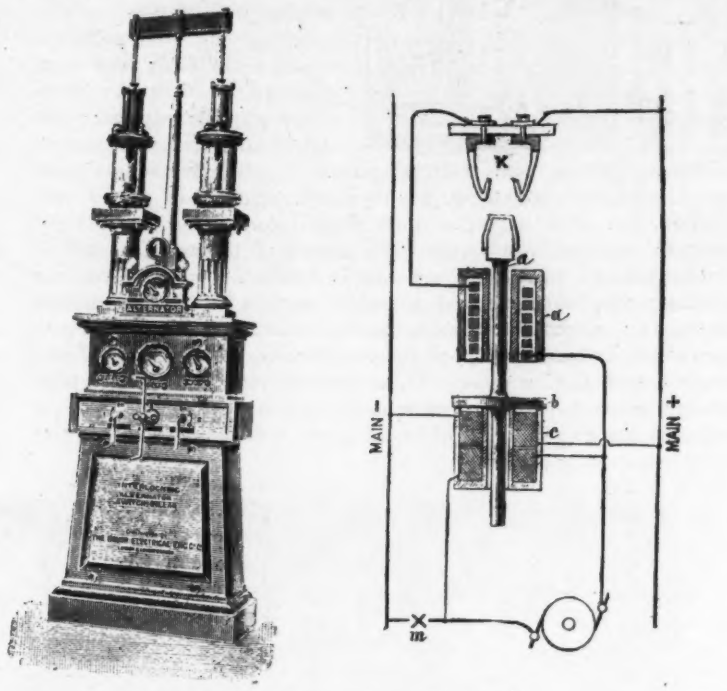


Fig. 3.—Switch Pillar.

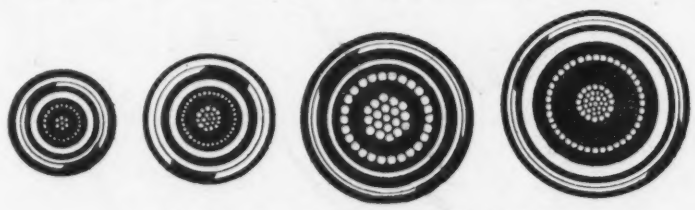


Fig. 4.—Cross Section of Cables.

The exciters are 12-kw dynamos, compound-wound and direct-driven. There are two machines, but one is capable of exciting the fields of all the alternators. The engines for these exciters are tandem compounds, fitted with Raworth's system of electric governors. By means of a resistance in the governor circuit the voltage of the whole station may be varied at will. There is no switchboard, a number of "switch pillars" serving in the place of one. The exciters feed into a pair of bus bars to which the alternator

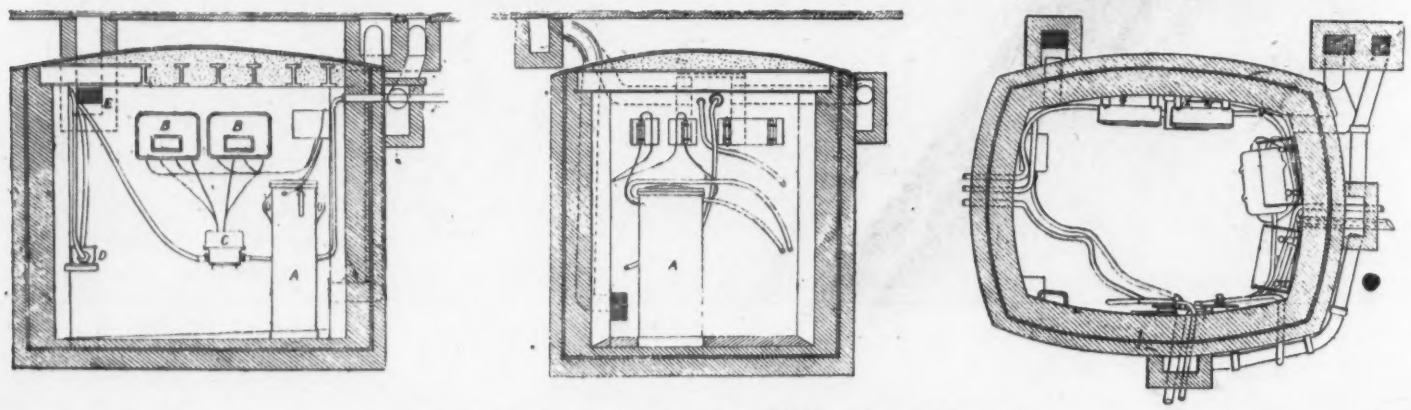


Fig. 5.—Cross-Sectional Views of Transformer Vaults.

fields are all connected in parallel. Near each exciter is a cast-iron switch pillar, which automatically closes the circuit when the E. M. F. of the exciter rises to that of the bus bars, and opens the circuit when the exciter E. M. F. drops below that of the bars. One of these pillars is shown in Fig. 3. Each alternator has a switch pillar containing a system of interlocked switches, which prevent the closing of the main circuit before the field circuit and

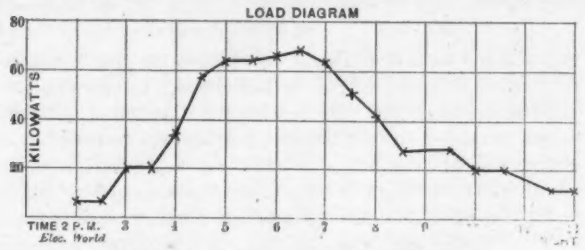


FIG. 6.—A JANUARY LOAD CURVE.

synchronizing circuit are closed, and also the opening of the field circuit while the main circuit is closed. A synchronizer is provided for each of these pillars, and is in mechanical connection with the main switch. Conductors are taken from the four "alternator pillars" to a "dividing table," and from thence through separate switches to two "circuit pillars" containing double-pole switches, fuses and ammeters for each of the two concentric feeders which carry current to the transformer sub-stations. The switch pillars are kept locked to prevent tampering.

The control of the E. M. F. of the whole station, as above stated, is effected by means of electrically controlling the governors of the exciter engines. Each exciter engine has a solenoid arranged to act upon the adjusting lever of the governor; the speed of the engine can, therefore, be varied by varying the current in the solenoid. The two solenoids are in parallel on a circuit which includes a rheostat. It is part of the system that the controlling solenoids shall be always in circuit, so that no exciter can be started without being at the same time under the control of the switch room. The action of the regulating circuit is to increase the speed of the exciter engines, so that in the event that the regulating circuit breaks down, the only effect would be that the E. M. F. would fall and would have to be raised by hand adjustment of the governors. The exciter circuits are not provided with any fuses whatever.

The underground cables, cross-sectional views of some of which are given in Fig. 4, are all of the Fowler-Waring concentric make, being lead-sheathed and armored with steel tape, excepting in the case of the high-pressure mains in the limited area where, as the cables have been laid in 3-inch iron pipes, no armoring is used. The outers of the system are grounded at the station through a switch at each of the "circuit pillars," so that each feeder may be disconnected from earth for testing. The two feeders running to No. 1 sub-station in Market Street are each about 1.5 miles in length, and are 0.146 square inch in section. From No. 1 station the high-pressure mains are run round the limited area in a ring main 0.097 square inch in section, the cable, which is braided over the lead sheathing, being run in 3-inch cast-iron pipes.

The transformer sub-stations are eight in number, and consist of vaults located under the sidewalks; each vault contains two or more transformers. Fig. 5 gives cross-sectional views of one of these vaults, which are all of the same size, namely, 5 feet 6 inches wide, 7 feet 6 inches long and 7 feet high. The sides and ends are curved outwardly about 6 inches. The walls of the vaults are formed of good hard bricks in cement in two thicknesses, with an inch space between. This space is filled in with specially prepared asphalt, which is also continued under the paving of the floor as well as over the roof, thus making the chamber perfectly water and gas tight. The roof is formed of rolled steel joists filled in between with cement concrete. A suitable manhole with double cover is provided for access to the chambers, which are descended by means of step irons built into the inner thickness of wall. All the chambers have an air inlet and outlet for securing proper ventilation. The bell mouths of the pipes carrying the high tension main are caulked with Vulcan cement, with the object of preventing any gas finding its way into the chambers. As an additional precaution against accidents, the pipes are provided with a ½-inch hole about a foot from the back of the wall of the vault, which communicates with a ventilating flue. This arrangement allows any gas which finds its way into the pipes escaping before reaching the vault. A similar arrangement with the same object is provided in connection with the low-tension cables.

The transformers are of the well-known Mordey-Victoria type, and each one is provided with a double-pole trigger switch enclosed in a cast iron box. The secondary terminals are connected to the distributing network through double-pole switches and fuses. The transformer cases, switch boxes and frames are all grounded to insure safety in handling.

The curve shown in Fig. 6 was taken on Jan. 8 last, and, judging from the population and the excellent service rendered it will probably not be long before the consumption reaches the maximum capacity of the station.

On a Possible Law of Residual Magnetism in Iron and Steel.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

So far as the authors are aware, no relation has been published between the magnetic intensity attained in a bar of iron or steel and the residual intensity upon the removal of the magnetizing force. We have discovered from a comparison of these values in those measurements made by Prof. Ewing which we have been able to examine, that a relation of a linear character seems to exist between these quantities, that is to say, any increase or decrease in the magnetic intensity produced in iron or steel appears to be followed by a corresponding increase or decrease of residual intensity in a fixed ratio; or, symbolically, if $\mathfrak{B}$, be the intensity produced in gausses, and $\mathfrak{B}_o$, the residual intensity or remanent magnetism, also expressed in gausses, after the magnetizing force is withdrawn, then,

$$\mathfrak{B}_o = a\,(\mathfrak{B} - c) \text{ gausses.}$$

This relation appeared from some measurements made by one of

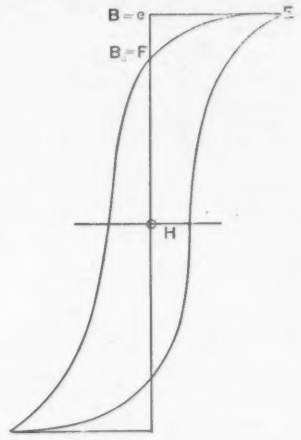


FIG. 1.

the authors, but we prefer, at the present time, to rest the evidence we have obtained entirely upon observations made by Ewing.

As is well known, a given magnetizing intensity $\mathfrak{H}$, produces a certain intensity of magnetic flux $\mathfrak{B}$ in a given specimen of iron or steel, and when the magnetizing force is removed, the magnetic intensity in the specimen falls to a residual value which we may call $\mathfrak{B}_o$. Or, as shown in Fig. 1, in a cycle of magnetic intensity $\mathfrak{B}_o$, rises under the application of $\mathfrak{H}$ to the value indicated at the point E, on the vertical scale. On the removal of $\mathfrak{H}$, or its reduction to zero, the intensity now falls along the line $E\,F$ to the value at F, or $\mathfrak{B}_o$, which is its residual value under these conditions. $\mathfrak{B}_o$ appears to be linearly related to $\mathfrak{B}$, that is to say, if we take a number of cycles for the same specimen of iron or steel and plot the values of $\mathfrak{B}_o$, as ordinates, to values of $\mathfrak{B}$ as abscissas, the values of $\mathfrak{B}_o$, fall upon what appears to be a straight line within limits of possible errors of observation.

Fig. 2 gives the result of plotting five series of observations given by Ewing. Curve No. 1 is taken from a diagram of cycles for a sample of soft iron published in the London *Electrician* for Jan. 11, 1895, Vol. XXXIV., No. 869, p. 298.

The maximum cyclic values are given numerically as well as graphically, while the residual values have had to be measured as closely as possible from the curves in the figure on page 298. The corresponding values are:

$\mathfrak{B}$	$\mathfrak{B}_o$
1,200	700
1,930	1,300
2,630	1,960
4,270	3,350
5 200	4,220
6,610	5,500
7,480	6,200

When $\mathfrak{B}_o$ is plotted in terms of $\mathfrak{B}$, in Fig 2, we obtain curve No. 1.

It will be observed that all the seven values fall very closely upon a straight line expressed by

$$\mathfrak{B}_o = 0.88\ (\mathfrak{B} - 400) \text{ gausses.}$$

In other words, if we substract 400 gausses from the maximum cyclic intensity, the residual intensity will be 88 per cent. of the difference.

On page 106 of "Ewing's Magnetic Induction in Iron and Other Metals" (1892), is a Fig. No. 50, in which the graded cyclic magnetizations in an annealed soft iron wire are given.

The following numerical values have been obtained from this figure:

$\mathfrak{B}$	$\mathfrak{B}_o$
12,070	9,800
11,900	9,550
10,620	8,922
9,048	7,477
7,288	5,906
6,032	4,901
3,896	3 016
2,262	1,257

Plotting these values we obtain curve No. 2, which gives a line practically parallel to curve No. 1, except that the two highest and lowest observations are somewhat in defect, as shown. The linear relation here being

$$\mathfrak{B}_o = 0.88\ (\mathfrak{B} - 500) \text{ gausses.}$$

The soft iron wire whose measurements are here recorded agrees very closely in its residual magnetism with those of the soft iron ring published by Ewing this year and above referred to.

On page 109 of Ewing's work already referred to, and in Fig. 52 appears a similar series of curves for a sample of annealed piano forte wire. From these curves the following numerical values have been obtained:

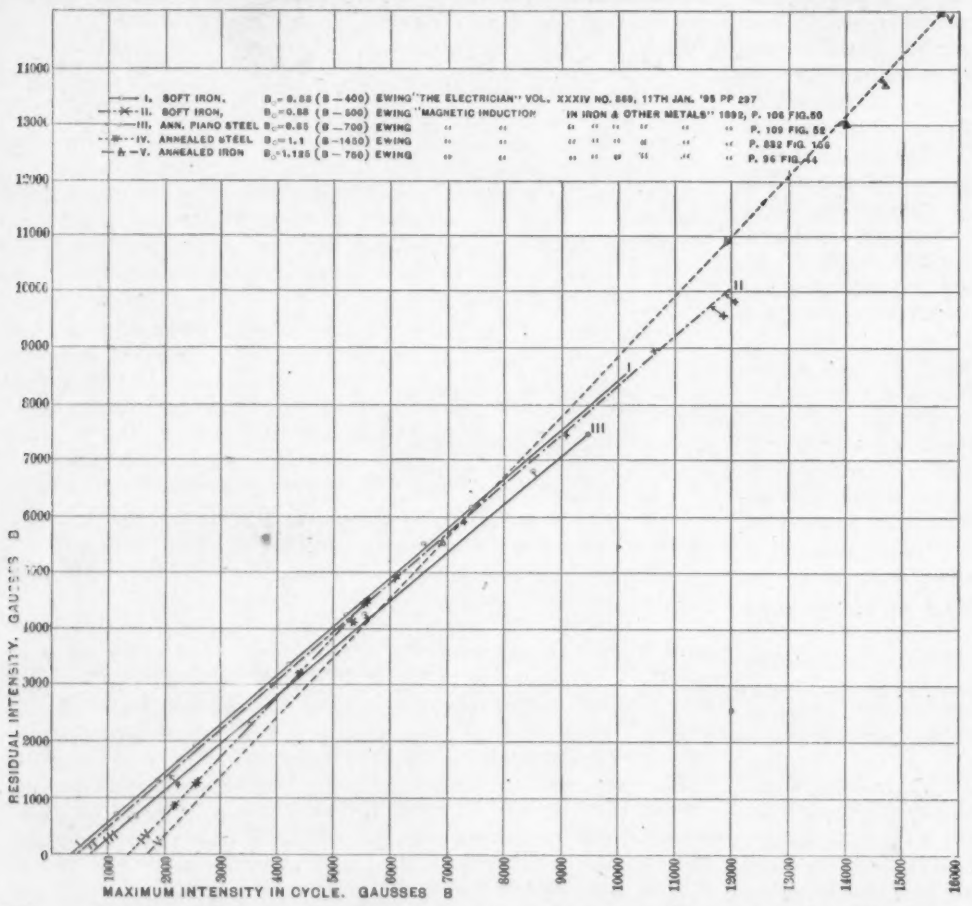

I. SOFT IRON, B_o=0.88 (B—400) EWING "THE ELECTRICIAN" VOL. XXXIV NO. 869, 11TH JAN. '95 PP 297
II. SOFT IRON, B_o=0.88 (B—500) EWING "MAGNETIC INDUCTION IN IRON & OTHER METALS" 1892, P. 106 FIG. 50
III. ANN. PIANO STEEL B_o=0.85 (B—700) EWING " " " " " P. 109 FIG. 52
IV. ANNEALED STEEL B_o=1.1 (B—1450) EWING " " " " " P. 332 FIG. 166
V. ANNEALED IRON B_o=1.125 (B—750) EWING " " " " " P. 96 FIG. 44
RESIDUAL INTENSITY. GAUSSES B
MAXIMUM INTENSITY IN CYCLE. GAUSSES B

FIG. 2.—DIAGRAM INDICATING LINEAR RELATION BETWEEN RESIDUAL AND MAXIMUM CYCLIC MAGNETIC INTENSITIES IN IRON AND STEEL.

$\mathfrak{B}$	$\mathfrak{B}_o$
9,426	7,540
7,540	5,780
5.655	4.273
3.645	2.388
1,508	691

These five observations fall fairly closely upon the line No. 3, represented by

$$\mathfrak{B}_o 0.85\ (\mathfrak{B} - 700) \text{ gausses.}$$

On page 332 appears the diagram of some cycles in annealed steel. It is interesting to observe that these cycles are distinctly dissymmetrical with reference to the origin, as is, in fact, pointed out in the text. The numerical values obtained from this diagram are:

$\mathfrak{B}$	$\mathfrak{B}_o$
5,350	4,120
5,500	4,400
4,400	3,200
2,600	1,250
2,200	850

On plotting these values we obtain the line No. 4, on which all the five stars lie,

$$\mathfrak{B}_o = 1.1\ (\ \ - 1450) \text{ gausses.}$$

This agreement with the linear relation is the more noteworthy owing to the dissymmetry in the cycles already referred to.

On page 96 appears Fig. 44, in which a number of observations made on an annealed iron wire are graphically recorded. In this case the wire was not subject to alternating magnetic force, but was advanced steadily through a unidirectional range of intensity. From the figure we obtain the following numerical values:

$\mathfrak{B}$	$\mathfrak{B}_o$
15,700	15,000
14,700	13,700
14,000	13,000
11,900	10,900
6,900	5,550

These values give the last line, No. 5, of triangles. All five fall very nearly upon the straight line.

$$\mathfrak{B}_o = 1.125\ (\mathfrak{B} - 1750) \text{ gausses.}$$

Laboratory of Houston and Kennelly, Philadelphia.

The Practical Aspect of Experimental Investigations.

In considering experimental work relating to the reduction of metals a certain sobriety of thought and statement is indispensable, says a writer in the London *Electrician*. There is but little lately accomplished in the production of any of the refractory metals which has not been performed years ago by the chemist engaged in purely scientific research. The only justification for satisfaction concerning larger scale experiments, and their easy and brilliant execution, is the consequent device of industrial methods and the discovery of some means of utilizing the products. Much nonsense is talked about possible new structural metals, the orators forgetting that the abundance of an element on the earth's surface is a weighty factor in its utilization. Glucinum is no doubt a nice material for many purposes, and its reduction is not beyond our means; but unhappily there is, so to speak, none of it. Even given abundance and fair ease of production, a "new" metal must be shown to be in some respect better than the older group before it can be more than a curiosity. Much more is to be hoped from persistent and enlightened experiment on the influence of small quantities of the more refractory metals on those longer and better known in the metallic state, with the view of obtaining alloys superior to those in common use.

Electric Lighting and Friendships.

Politics and sectarianism, says the London *Electrician*, especially of the village order, have done not a little in their time to embroil peace-loving folk. But if a Fareham rate-payer is to be believed, electric lighting promises to become an equally potent cause of disturbance. Speaking at a recent meeting of rate-payers, held to discuss what steps should be taken to bring the pending litigation between the Fareham District Council and the Fareham Electric Light Company to an amicable termination, Mr. Dodds is reported to have said that "the electric light question had torn asunder friendships that had lasted for years, and men now passed each other in the street like dogs." What an excellent advertisement this sad state of things would make for, say, incandescent gas: Warranted to give n candles for $n-x$ cubic feet of gas and to destroy no friendships.

Rope Driving.—XVIII.

BY J. J. FLATHER.

It is evident that in order to prevent slip and the loss of power incident thereto, it will be necessary to obtain a uniform velocity in the several ropes running over a pair of pulleys; to approach this desideratum each set of ropes should be of the same make and degree of hardness, of uniform diameter, evenly spliced, having the same amount of sag in both members, and run over grooves of uniform diameter, shape and smoothness.

Obviously it would be impossible in practice to maintain all these conditions, even if it were practicable to overcome the mechanical difficulties and install a plant under the given requirements; yet much may be done to affect the desired end.

Uniformity of length is an important requirement, as, if one rope of a set be allowed a less amount of sag than the others, the sum of the tensions will be greater in this rope, and in consequence it will be drawn more deeply into the groove; its pitch diameter will therefore be reduced, and its velocity will be different from the others in the set; in which case if the driving and driven pulley are of unequal diameters the tendency will be to give the driven pulley a different velocity, and slip must necessarily occur.

The following from the *American Machinist* is pertinent to the subject:

"It will be readily seen that in a set of ten or a dozen ropes, each of a somewhat different length, the loss of power from this cause may easily become a very serious item, and to this there is to be added the correspondingly diminished life of the ropes. A similar action occurs when worn ropes are allowed to work conjointly with new, even though the sags, and, therefore, the tensions, on the several ropes are practically equal. In this case the loss due to abnormal tension and wedging of some of the ropes into the grooves is avoided, but the differential driving effect due to the ropes virtually running on pulleys of different diameters still exists, and is equally objectionable. It may here be noted that the effect of the differential driving upon the ropes depends to a very large extent upon the relative diameter of the two pulleys."

It is evident that, when the driving and driven pulleys are of the same diameter, any variation in the effective pitch diameters of the several grooves will have no appreciable effect upon the transmission, provided that the diameter and shape of the corresponding grooves in the two pulleys are the same. It may be noted, however, that the worn ropes which run deeper in the groove, having a slightly diminished velocity, are subjected to a somewhat greater stress than their newer and larger companions.

With a form of groove similar to that shown in Fig. 45, in which

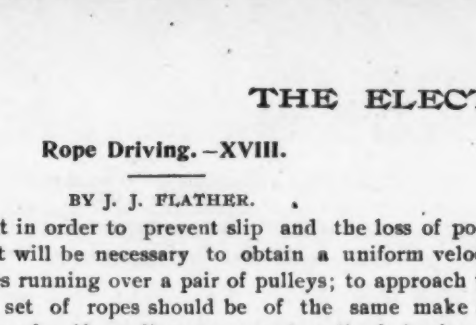


FIG. 45.

the sides of the grooves are circular arcs of large radius, there will be a tendency to correct the differential driving, especially so when the driving pulley is smaller than the driven. In this case if we assume that all the ropes in a set are put on with the same amount of sag so that the tensions are practically equal for both old and new ropes, any difference in diameter of rope will cause the larger to carry more than its share of the load, since the effective radius of the pulley and therefore the velocity of the rope is greater; moreover since the coefficient of friction varies inversely with the depth of contact in this form of groove, the larger rope is acted upon by a more intense grip, by reason of which more work is imposed upon it, while a smaller rope will be relieved of some of its work. The tendency of the larger rope is to turn the driven pulley at an increased velocity.

Thus, in Fig. 46 if D be the driving pulley and F the follower, with respective diameters such that the velocity ratio $\frac{R}{r}$ is one to three, then the smaller ropes, o, will tend to drive F in the ratio $\frac{1}{3}$ while the larger ropes n working at a distance x farther away from the centre of pulleys, will tend to drive F in the ratio $\frac{1+x}{3+x}$ and therefore at a higher velocity. The resulting velocity of the follower will depend upon the work done by each rope so that

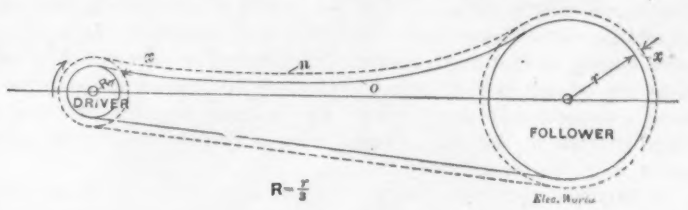


FIG. 46.

some slip must necessarily occur; on account of the greater load taken by the larger ropes they will be rapidly compressed and worn, so that any initial variation in turning effort will be speedily reduced to a minimum by this equalizing process, which, although it incurs loss, ultimately insures a better distribution of the work with the least wear on the ropes.

On the other hand, when the driving pulley has a greater diameter than the follower, the larger ropes are drawn less deeply into the grooves and tend to impart a lesser velocity to the driven sheave. Thus, in Fig. 47 the large pulley is the driver and the velocity ratio is $\frac{R}{r}=\frac{3}{1}$ with the smaller ropes, o; with the larger ropes, n, working at a distance x nearer the circumference the tendency will be to produce a ratio equal to $\frac{3+x}{1+x}$ hence the effect will be retardation. Since the larger ropes acting higher in

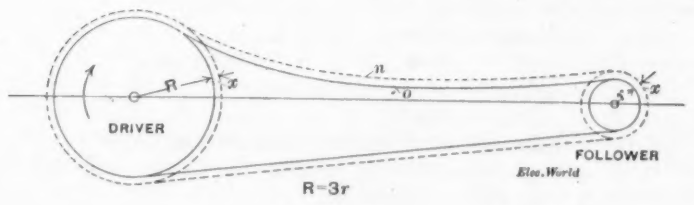


FIG. 47.

the groove have an increased grip and speed they will exert a greater influence upon the smaller pulley, and although the smaller ropes may be drawn more deeply into their grooves in attempting to drive the follower at a greater number of revolutions per minute their effect is lessened on account of the diminished grip, due to the form of groove, in consequence of which the larger rope acts with a greater effect and the smaller with a lesser effect than would obtain with an ordinary V-groove under like conditions.

To equalize the driving efforts of a number of ropes and to prevent the slip which must inevitably occur with a solid grooved rim, Mr. John Walker has devised and patented* a "differential" driving pulley, since it allows the ropes to travel at different speeds suited to the conditions imposed upon each rope.

Originally intended for cable railway machinery where the wear on the drums due to the wire cable is excessive, the differential

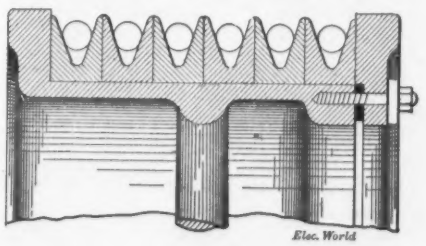


FIG. 48.

principle has been extended to other uses—notably elevator sheaves and rope transmission pulleys.

In the latter the rope is led over a number of separate rings, Fig. 48, adapted to turn loosely and independently of each other on the smooth circumference of the drum.

While the rope is passing over the pulley the tendency of the

*Feb. 28, 1892.

rings will be to adjust themselves to the strain in each member by moving around the circumference of the drum; thus the driving tension is equalized and each rope is brought to do its own share of the work without slipping in its groove. These rings have a diametrical friction, due to the pressure of the rope in the groove transferred to the flat surface of the drum; in addition to this, an adjustable rubber washer is inserted between the rim of pulley and loose flange, so that by tightening this adjustable joint the separate rings are caused to exert enough pressure upon each other to produce a certain amount of friction on the side surfaces, the combined friction of the several rings being sufficient to drive the pulley or ropes as the case may be.

In this way each rope bears its due share of the work, as the adjustment is such that the friction between pulley and rings, rings and rope, are brought into equilibrium.

In practice, the axial rotation of the ropes will frequently exert a modifying influence on the differential driving, since other conditions being unchanged, a rotating rope tends to maintain its circular form and therefore will work less deeply into its groove than one which does not possess this property. An additional advantage is that such rotation promotes the durability of the rope as the wear is more uniform.

The loss due to the elastic slip, or creep, of the belt has some influence upon the efficiency of transmission, but in any case its effect is small. When an elastic body, such as a rope, is placed under tension it stretches, and the elongation, within the limit of elasticity, is proportional to the strain in the rope. When power is transmitted from one pulley to another by a rope the driving side is subjected to a greater tension than the slack side, in consequence of which the velocity in the driving side will be slightly greater than that in the slack side, and the circumferential velocities of the two pulleys will not be the same. This will be evident from the following considerations:

Let V = circumferential velocity of driver;
" V' = " " " " follower;
" T_1 = tension in driving side of rope;
" T_2 = " " slack " " " ;
" A = cross-section of rope in square inches;
" L = original length of a piece of the rope in either side in its normal condition;
" e = elongation in driving side due to tension T_1;
" e' = " " slack " " " " T_2;
" E = modulus of elasticity of the rope.

When the rope is at work $e = \frac{T_1}{EA}$ and $e' = \frac{T_2}{EA}$ so that the length of each member will now be $L + e$ and $L + e'$ respectively; the length of rope running on to the driving pulley in a unit of time will therefore be greater than that delivered to the driven pulley in the proportion $\frac{L+e}{L+e'}$, and the velocity of the two pulleys will now be $\frac{V}{V'} = \frac{L+e}{L+e'}$; hence, $V' = V \times \frac{L+e'}{L+e}$.

Calling L unity and assuming $\frac{T_1}{T_2} = 2$, $\frac{T_1}{A} = 320$ pounds, since $T_1 = 200\,d^2$ pounds, and $A = 0.8 \times \frac{\pi}{4} d^2$, and $E = 40{,}000$*, we have $e = \frac{320}{40{,}000}$ and $e' \frac{320}{2 \times 40{,}000}$, therefore,

$$V' = V \times \frac{1 + \frac{320}{80{,}000}}{1 + \frac{320}{40{,}000}} = 0.996\ V,$$

that is, the loss due to creep when all the ropes are working under normal conditions is about one-half of one per cent. With different ratios of driving to tight side tension and different intensities of stress it is evident that this loss will vary in the different ropes; in any case the loss ought not to exceed one and one-half per cent. as will be seen if we assume extreme conditions.

For instance, let the stress on the rope be 600 pounds per square inch of section and assume the ratio of tensions equals one-fifth; with the most elastic long staple cotton rope it is possible that the modulus of elasticity may be reduced to 30,000 pounds; therefore, under these conditions the velocity of the circumference of the driven pulley will be

$$V' = V \times \frac{1 + \frac{600}{5 \times 3{,}000}}{1 + \frac{600}{30{,}000}} = 0.984\ V,$$

thus representing a loss of 1.6 per cent. It is probable that one per cent. is an ample allowance even under unfavorable conditions.

The construction of rope pulleys is a matter of considerable importance, for it is evident from what has preceded that the size, shape, and condition of the pulley all exert a marked influence upon the efficiency of rope transmission. It has been shown that the size of the pulley materially affects the wear of the rope; the larger the sheaves, the less the fibres of the rope are flexed, and the less they slide on each other: consequently there is less internal wear of the rope.

The minimum diameter of the pulley as given by different authorities varies from 30 to 40 times the diameter of rope to be used. Forty times the diameter of rope for manilla is excellent practice, and experience has shown that a larger multiplier would be still better, as the larger a pulley, the better for either belt or rope passing over it; but such a rule, although convenient to use, was evidently founded upon large-sized ropes running at a high velocity, and a little consideration will show that while 40 times the diameter of rope may be all right for a two-inch rope it is also true that a lesser proportion will give suitable diameters of pulley for a one-inch rope. If we take two ropes d_1 and d_2 whose diameters are one and two inches, respectively, and bend them over pulleys of the same diameter, the fibres in d_1 will be stressed an amount equal to x, due to the stretch and sliding of the fibres one upon another; on the other hand, since the outer fibres in d_2 are twice as far from the neutral axis these fibres will stretch and slide upon each other to an extent equal to twice that produced in the smaller rope; but the relation of the areas of the two ropes is $\frac{\frac{\pi}{4} d_2^2}{\frac{\pi}{4} d_1^2} = \frac{d_2^2}{d_1^2} = 4$ in this case, hence the total slip in the larger rope due to the sliding of the fibres upon each other will be eight times greater than in the smaller one or as $\frac{d_2^2}{d_1^2}$; therefore, for equal extension and slip of the fibres in bending a rope over a stationary pulley, it would appear that the pulleys should have diameters proportional to the cube of the diameters of the ropes.

In the above consideration no account has been taken of the external wear, produced by slipping in the groove, wedging, rubbing contact and other causes of loss which affect a running rope; for a given velocity these losses will increase with an increased speed of rotation and hence will be greater with a smaller pulley, which would indicate that the diameter of the latter should not be directly proportional to the cube of the diameter of the rope, it is also evident that a rope running at 5,000 feet per minute will be subjected to a greater number of bends and a greater external wear than it would if running over the same pulleys at 2,000 feet per minute.

The first of these influences is recognized by many engineers who use a rule approximating the following:

For the least diameter of pulley, D, multiply the circumference of rope by ten times its diameter and divide by 2.† This is practically equal to $D = 15\,d^2$ inches.

While we believe in using as large a pulley as possible in any given case, conditions will arise when it is desirable to use the smallest possible diameter without excessive injury to the rope. In such case the individual circumstances should be considered by the designer.

(To be continued.)

* See Reports of Tests on Manilla Rope. Ex. Doc. No. 36, 1885.

Electrification of Air.

Lord Kelvin in a recent paper states that he found the difference of potential between the earth and an insulated burning match at a height of nine feet, to vary from 200 to 400 volts, rising in some cases to 3,000 or 4,000 volts, the potential being always positive, that of the earth being considered zero. To inventors who will immediately propose to utilize this as a cheap service of electrical energy, we suggest that it would be well to first find out how many (or better, how few) coulombs there are in back of these volts.

†Mr. James Gamble, in *Textile Recorder*.

Electrodynamic Machinery.—XXXVII.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

244. When two or more generators are connected in parallel, it becomes necessary that the electromotive forces they supply shall be equal, within certain limits. If, for example, two generators are connected in parallel, each working at half load, then if the drop of pressure in each generator armature at full load is two per

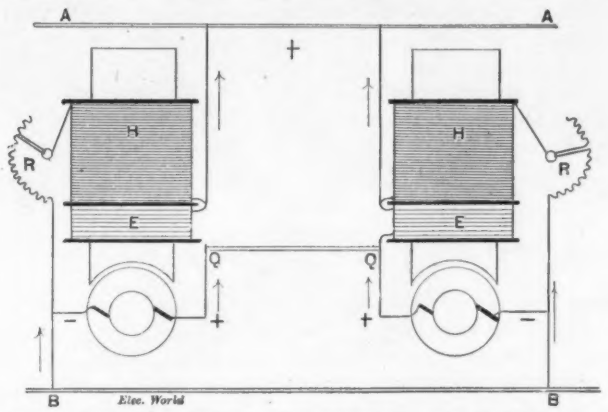


FIG. 169.—PARALLEL CONNECTION OF COMPOUND-WOUND GENERATORS.

cent. of its total E. M. F., it is evident that it is only necessary to increase the pressure of one generator two per cent. above that of the other, in order that the pressure at brushes of the first shall be equal to the E. M. F. generated in the armature of the second. Under these circumstances no current will flow through the armature of the second machine, and all the load will be thrown on the first machine. If the E. M. F. of the first machine be still further raised, the pressure at its brushes will be greater than the E. M. F in the armature of the second, and a current will pass through the second armature in a direction opposite to that which it tends to produce, and, therefore, in a direction tending to rotate the second generator as a motor. In other words, the control of pressure between the two machines must be within closer limits than two per cent. Early in the history of central station practice difficulties were experienced in controlling the pressure of multiple-connected

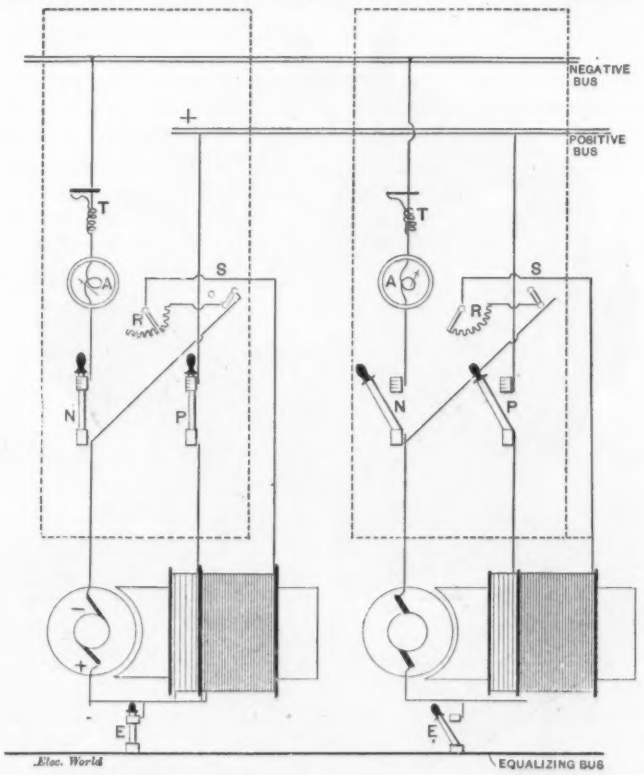


FIG. 170.—DIAGRAM OF SWITCHBOARD CONNECTIONS FOR TWO COMPOUND-WOUND GENERATORS.

dynamos within limits necessary to avoid this unequalizing action, but at the present time the governing of the engines and the control of the field magnets are so reliable that this difficulty has practically disappeared. It is important to remember, however, that the larger the generator unit employed, and the smaller the drop in pressure taking place at full load through its armature, the narrower is the limit of speed or regulation, in which independent

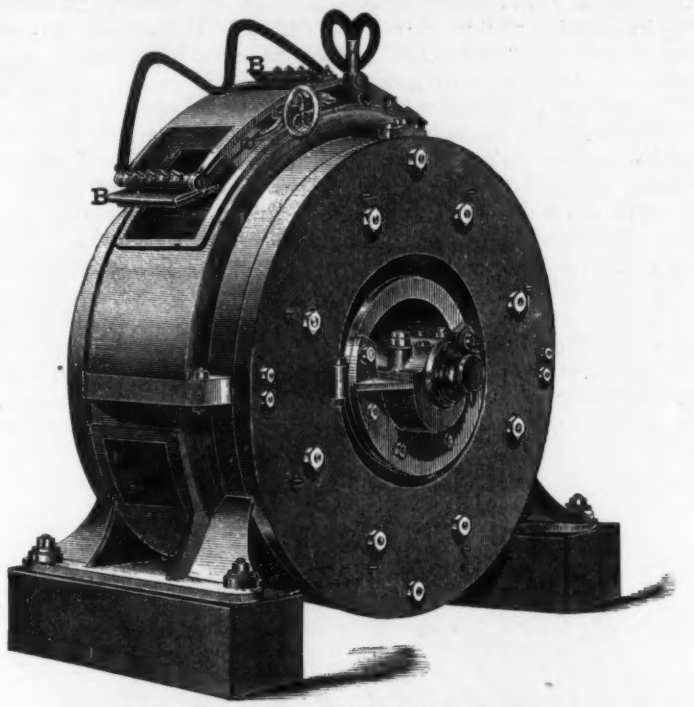


FIG. 171.—DISC-ARMATURE GENERATOR.

units will equalize their load, although as a counteracting tendency, the larger will be the amount of power which, in case of disequalizing, will be thrown upon the leading machine tending to check its acceleration.

245. Compound-wound generators are almost invariably employed for supplying electric currents to street railway systems. This is principally for the reason that the load in a street railway system is necessarily liable to sudden and marked fluctuations, and these fluctuations would be liable to produce marked variations in the pressure at the generator terminals, if the machines were merely shunt wound. Such generators are operated in parallel units.

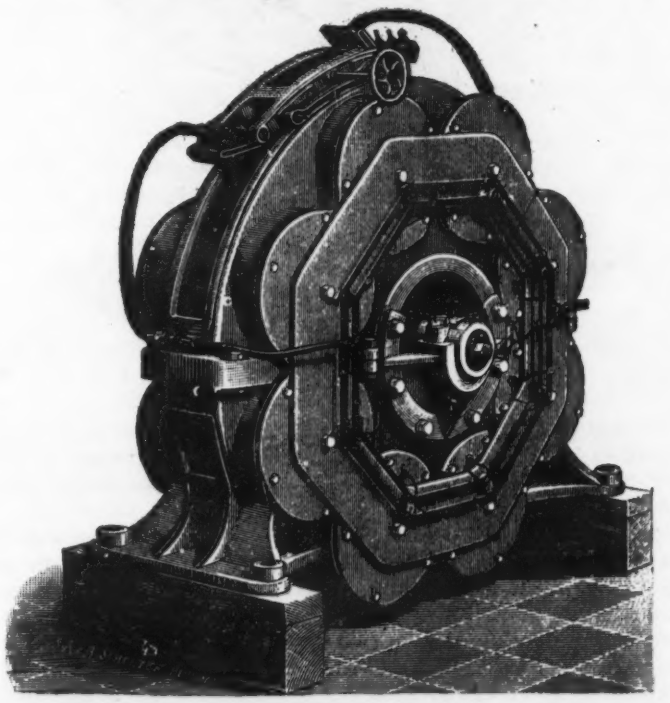


FIG. 174.

Here, as in the case of shunt-wound machines, it is necessary that the E. M. F. generated by each machine should be nearly the same, in order that the load should be equally distributed; but instability of control is greater in the case of compound-wound machines than

in the case of shunt machines, for the reason that when one of a number of parallel-connected shunt-wound machines accelerates, and thereby rises in E. M. F., so as to assume an undue share of the load, the drop in the armature thereby increases and tends to diminish the irregularity, so that not only does the greater load tend to retard the engine connected to the leading machine, but the drop in its armature aids in equalizing the distribution.

In the case of compound-wound machines in parallel, any acceleration tends, as before, to increase the E. M. F. of the generator and, therefore, its share of the load, but the series coil of the compound winding being excited by the additional load, tends to increase the output of the machine, and, therefore, the governing of the engine has to be entirely depended on to prevent disequalization. Of recent years, however, the plan has been widely adopted of employing an *equalizing bar* between compound-wound generating units operated in parallel. The connections of an equalizing bar are shown in Fig. 169. Here the two compound-wound generators are connected to the positive and negative *omnibus bars*, or *bus bars*, as they are generally termed, *AA* and *BB*, while the series coils are connected together in parallel by the equalizing bar *QQ*. It is evi-

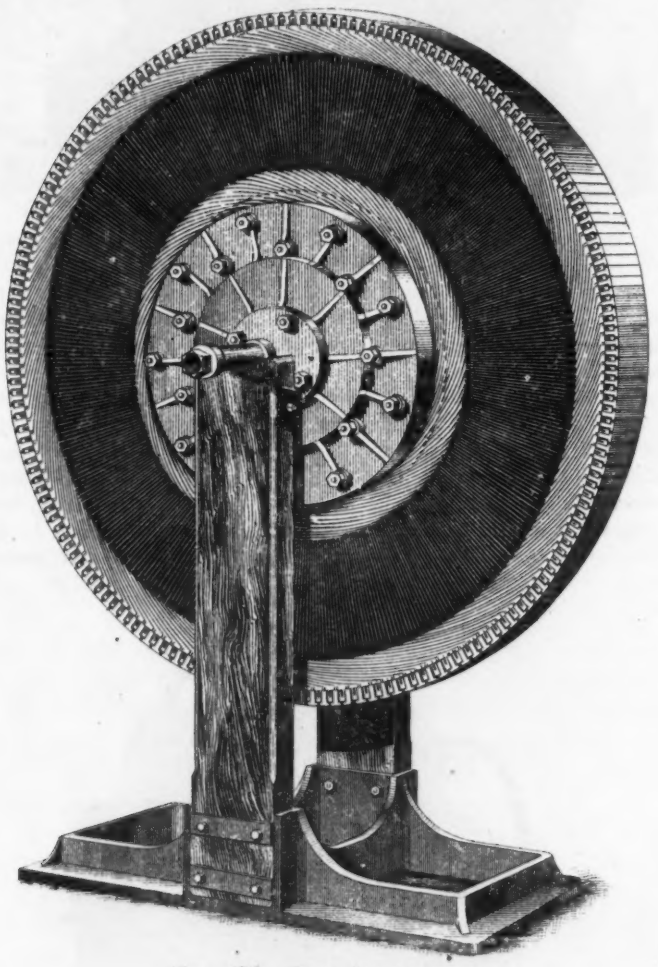


FIG. 172.—DISC ARMATURE.

dent that the equalizing bar connects all series coils of the different dynamos in parallel, so that any excess of current supplied by the armature of one machine must necessarily excite all the generators to the same extent.

246. When a number of compound-wound generators are running in parallel, and the load increases so that it is desired to add another unit to the generating battery of dynamos, the engine connected with the new unit is brought up to speed, and the shunt field excited. This brings the E. M. F. of the machine up to nearly 500 volts. Its series winding is then connected in parallel with the series winding of the neighboring machines, by the switch on the equalizing bar, so that its excitation is then equal to that of all the other machines. The E. M. F. of the machine is then brought up slightly in excess of the station pressure by the aid of the field rheostat, and, as soon as this is accomplished, the main armature switch is closed, thus connecting the armature with the bus bars. The load of the machine is finally adjusted by increasing the shunt excitation, with the aid of the rheostat, until the ammeter connected with the machine shows that its load is approximately equal to that of the neighboring generators. The same steps are taken in reverse order to remove a generator from the circuit.

247. Fig. 170 is a diagram of a street railway switchboard for two generators. It is customary, for convenience and simplicity, to erect switchboards in panels, one for each generating unit, so that each panel controls a separate unit and is in immediate connection with its neighbors. In the figure the two panels are designated by dotted lines, the one on the left, active, and the one on the right, out of use. On each panel there are two main switches, *P* and *N*, for the positive and negative armature terminals. A smaller switch, not shown, is usually located on the right of each panel and is for lighting up the station lamps from any panel and its connected machines at will. *R* is a shunt rheostat, placed at the back

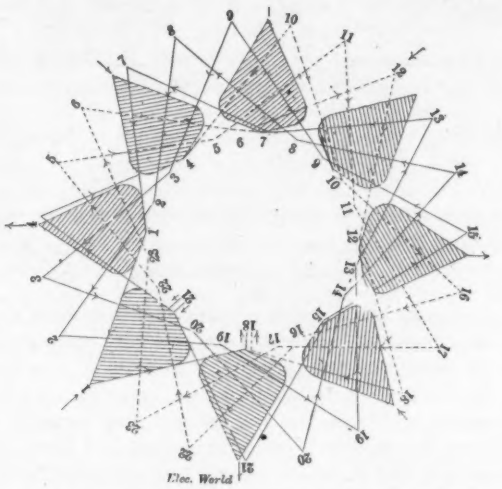


FIG. 173.—DIAGRAM OF DISC ARMATURE WINDING.

of the panel, with its handle extending through to the front, and *s* is a small switch for opening and closing the shunt circuit of the field coils through the rheostat, *R*. *A* is the generator ammeter brought into use by the switches *P* and *N*, and *T* is the automatic circuit-breaker for the panel. This electromagnetic circuit-breaker breaks the circuit of the machine when the current

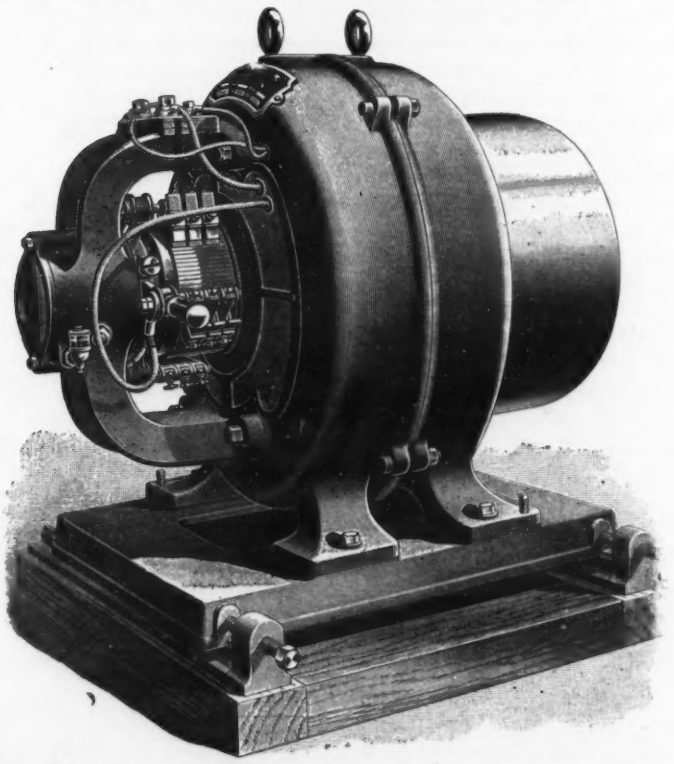


FIG. 175.—COMPOUND-WOUND GENERATOR WITH SINGLE FIELD COIL.

strength, owing to a short circuit or other abnormal conditions, becomes dangerously great, thereby relieving the generator of the strain. The switch connected to the equalizing bar *E* is not placed, in this instance, on the panel, but is mounted close to the generator

with the object of diminishing the amount of copper conductor required. Each panel is also provided with a voltmeter connection and lightning arrester, which have been omitted here for the sake of simplicity.

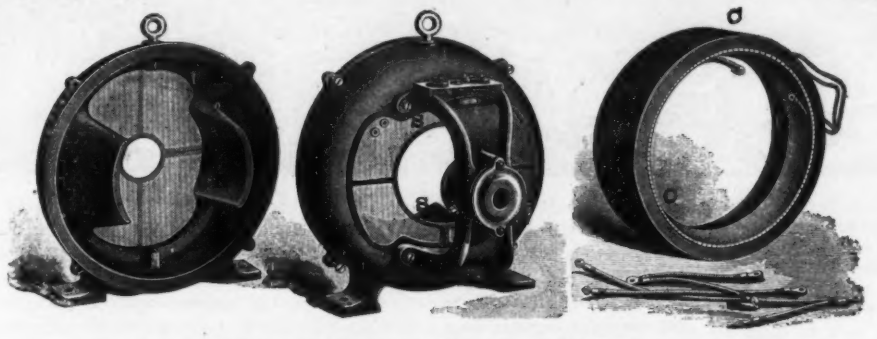


FIG. 176.—DETAILS OF MAGNET, SINGLE FIELD COIL GENERATOR.

248. The operations for introducing a unit into the battery of generators is, in this case, as follows: the generator is brought up to speed, the equalizing switch is closed, thus connecting the series coils of the machines in parallel with the machines in use. Next the positive main switch *P*, is closed, connecting one side of the armature to ground and return track feeders. The field switch *s*, is next closed, and the E. M. F. of the machine is brought up to slightly above station pressure by the aid of rheostat *R*; finally, the negative main switch *N*, is closed, throwing the armature into the battery, and the load is adjusted by the rheostat *R*, in accordance with the indications of the ammeter *A*.

249. Another arrangement for railway switchboards consists in mounting the three switches, *P*, *N* and *E*, in close proximity to each other and attaching a single handle to the three blades, so that the three connections may be made or broken by a single operation.

When the railway mains are connected with the station by several feeders, it is customary to add another section to the switchboard where switches and ammeters are provided for handling the various feeders.

250. Before leaving the subject of generators it may be well to discuss a few types of generators that do not fall under the types already discussed and which are less rarely met with in practice.

These may be described as,

(1.) Disc-armature machines.

(2.) Single field-coil machines.

(3.) Unipolar machines, or commutatorless continuous-current machines.

251. Generators employing disc armatures are frequently employed in Europe, and although they are very seldom employed in the United States, yet it is proper to describe them as being types of machines capable of efficient use. In one form of disc-armature generator, the armature is devoid of iron, and is built of conduct-

FIG. 177.—ARMATURE OF QUADRIPOLAR, SINGLE FIELD-COIL MACHINE.

ing spokes like a wheel, which revolves in a vertical plane between opposite field magnet poles. Such a disc armature machine is shown in Fig. 171. It is to be observed that the entire machine is practically encased in iron and is provided with three windows on the vertical face; through these windows the brushes, *BB*, rest on the commutator which is placed on the periphery of the disc. The armature of this machine is shown in Fig. 172 supported on a small truck. The radial spokes are of soft iron, and are connected into loops by the copper strips leading to the commutator segments of the periphery. The object of employing iron spokes is to diminish the reluctance of the air-gap. Such an armature is evidently capable of being operated at an abnormally high temperature without danger, being constructed of practically fireproof materials. The electrical connections of an octipolar machine are represented diagrammatically in Fig. 173. The brushes, it will be observed, are applied at the centres of any adjacent pair of poles. Another form of the machine is represented in Fig. 174.

252. An example of a single field coil multipolar dynamo is shown in Fig. 175. This is a quadripolar generator with four sets of brushes. The interior of the field frame, with its projecting pole pieces and exciting coil, is shown in Fig. 176. It will be seen that the field frame is made in two halves, between which are enclosed the armature and the single field magnetizing coil. Four projections *N*, *N*, and *S*, *S*, form the pole pieces of the quadripolar field; that is to say, the magnetic flux produced by the M. M. F. of the single coil *C*, *C*, passes through the field frame into the two pole faces *N* and *N*, in parallel through the armature into the adjacent pole faces *S*, *S*, thus completing the circuit through the field frame. The armature, which is a drum-wound, tooth-cored armature, is shown in Fig. 177.

(To be continued.)

Laboratory of Houston & Kennelly, Philadelphia, Pa.

Electric Lighting in Montevideo.

The following information relating to electric lighting in Montevideo, South America, is contained in a recent United States Consular report:

Until about 1888, the public lighting of Montevideo was done under contract with the Montevideo Gas Company, an English corporation, which had a monopoly. A company was then formed with home capital to furnish better lighting, either by gas or electric light, and, amidst great difficulties, an electric light plant was put up and a contract made with the municipality to furnish a part of the most populous section of the city, the so-called *Centro*, with electric lights. About two years later another plant was put up to supply the remainder of the city. The municipality imposes a separate tax for public lighting, which brings about $90,000 annually, out of which this service is paid.

The alternating system is used, the apparatus being that of Ganz, Budapest. In the central station there are three alternators of 80-kw capacity. Three thousand two hundred lamps of 12 cp are in service. Commercial houses are served until midnight. In the Arroyo Seco station there are two direct-coupled alternators of 320 kw each, and five others of 80 kw. Five thousand lamps are in service, of which 3,400 are public lights, for which latter the city pays $3.15 (gold) per month; commercial houses pay 36 cents per kilowatt-hour and private houses 48 cents.

The use of electricity as a motive power has not yet been introduced in the country. Besides Montevideo, there is no other city or town in the Republic of Uruguay, with the exception of San Jose, with electric lighting.

A Peculiar Phenomenon.

To the Editor of The Electrical World:

SIR:—In connection with the electrical jets or brush discharges observed on barbed-wire fences and on the handles of his bicycle by T. A. Peplow at Lamar, Col., on April 26, 1895, and described in THE ELECTRICAL WORLD, May 18, on page 586, it may be of interest to note that the date which he mentions was that also of an aurora and considerable prevalence of thunderstorms. There is considerable evidence that such a phenomenon as that observed at Lamar in this instance is an incident in a general increase in atmospheric and terrestrial electrification due to an inductive effect proceeding from the sun and affecting the entire earth in accordance with the laws governing the mode of operation of forces of this kind, brush discharges, or disruptive effects, appearing only at certain points where the local conditions are favorable, or the poles induced are situated. The special solar conditions on which such inductive effects depend are just coming to be understood. There appears to be a form of action entirely independent of the radiation of heat or light that requires to be identified and studied by itself. This mode of solar action appears to depend upon conditions that are accurately defined, and that are essentially dynamic. It is the turmoil of eruptive activities at a certain point on the sun as viewed from the earth that gives rise to these inductive effects.

LYONS, N. Y. M. A. VEEDER.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

BY CARL HERING

COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

Note.—The object of this department is to give a digest of the principal technical articles on electrical subjects appearing in American and foreign periodicals. The abstracts will contain, briefly, the nature of the article, its object, and the most important data or conclusions, as far as the limited space will admit. Abstracts made by the authors, editors, or publishers are solicited and should be sent to the Philadelphia office of THE ELECTRICAL WORLD, 927 Chestnut street. They should be forwarded so as to be received at least as early as the journal in which the original articles appear; they should not be longer than the importance of the subject warrants, and must comply with the general outline given above, the compiler reserving the right to edit or reject them. Such abstracts may be sent in the English, French, or German languages. It will be to the advantage of all concerned if editors of non-electrical journals, or of such electrical journals as are not regularly abstracted, will send the compiler a copy, specially marked, in which any important electrical article appears.

DYNAMOS, MOTORS AND TRANSFORMERS.

Calculation and Construction of Continuous-Current Dynamos.—Mr. Picou's article (see Digest last week) is continued in "L'Eclairage Elec.," May 4; he discusses a number of details and check calculations; among other things he states that 25 watts per square decimeter (1.6 watts per sq. in.) is the limit for the number of watts converted into heat in the armature, which can be dissipated from its surface without heating it too much; he compares different ways of winding armatures. The article is of a thoroughly practical nature but does not admit o being abstracted.

Construction of a Sewing Machine Motor.—An illustrated article describing the construction in detail of a small motor is published in "L'Elec.," May 11.

Theory of Synchronous Motors.—In the Digest, April 20 and March 9, mention was made of an article by Prof. Blondel; the complete article, only a portion of which was published in the French journal, is published in pamphlet form by Lahure of Paris; a brief statement of the nature of the article was given in the Digest references.

Transformer of Alternating into Continuous Currents.—A paper by Mr. Dèri read recently in Vienna and describing a transformer made by Ganz, is abstracted briefly in the "Bul. Soc. Int. des Elec." for April; it consists simply of a four-pole dynamo having ring collectors and an ordinary commutator.

LIGHTS AND LIGHTING.

Carbon Economizer.—According to "L'Eclairage Elec.," May 4, tests made by the Edison Company in Paris of the apparatus described and illustrated in the Digest, Dec. 8, have confirmed the results previously obtained. Two lamps were connected in series, one having square carbons 12 mm to the side, and the other 17 mm to the side, the former being provided with the economizer; under these conditions the carbons in both lamps lasted the same time; the illumination at 36 paces from the former was equal to that at 32 paces from the latter, corresponding to about 26 per cent. increase in the light from the lamp which contains the economizer; there is therefore no doubt that it is economical to use the apparatus; it was found, however, that with the density of the current used, namely, 1 ampere for 144 sq. mm of cross-section of carbon, the insulating material of the hood deteriorates quite rapidly. A more resisting material should therefore be used.

Incandescent Lamps.—An abstract of the article by Mr. Armagnat, mentioned in the Digest, April 6, is published in the Lond. "Proc. Phys. Soc." for May.

Solar Arc Lamp.—Mr. Sachs gives a description of the principle of this lamp, accompanied by illustrations, in the "Elec. Eng.," May 22.

POWER AND HEAT.

Dock Cranes.—Lond. "Engineering," May 10, gives a brief description accompanied by good illustrations of the electric jib crane at the Hamburg docks. It states that electric cranes are now being introduced and promise to be very successful; at first, electric cranes were a failure, but the difficulties have now been overcome; for docks only one method of operating the motors has been found satisfactory (but this method is not described); the throwing in and out of the motor must be gradual; there must be two independent motors, one for lifting and the other for turning. Long-continued tests gave the following comparative results regarding the coal consumption: with the electric crane, using a triple expansion steam engine, the consumption of a certain operation was 4 kg of steam and under the same circumstances the steam crane consumed 10 kg; the difference in coal consumption will be greater still since the small boilers of steam cranes cannot work as economically as the large boilers for central stations; a steam crane of a certain type always consumes the same amount of steam no matter what the load, while the running requirements of the electric crane are fairly proportioned to the load; the mean efficiency of a hydraulic plant measured between the accumulator and the load raised, was found to be about 60 per cent.; that of the electric crane measured between the switchboard and the load raised was about the same; the electrical energy, however, can be produced by 8 to 10 kg of steam per horse-power per hour while the hydraulic energy, as measured behind the accumulator, required not less than 15 to 20 kg; thus the electrical crane consumes only about half the steam that the hydraulic crane does.

Long Distance Transmission at Genoa.—"L'Elettricista," May 1, contains some further data regarding the well-known high tension continuous current transmission plant from Isoverde to Genoa; four large batteries of Tudor accumulators capable of storing 840 hp-hours, have been installed. The same plant now furnishes power for lighting the town of San Pier d'Arena by means of a Thury dynamo motor.

Three-phase Transmission Plant at Foligno.—According to "L'Elettricista," May 1, the plant at Foligno has been tested and has proved to be satisfactory; it is intended to be started in a few weeks; 400 hp derived from the river Menotre by means of three turbines directly coupled to dynamos making 500 revolutions, is transmitted four miles at 2,000 volts.

Transmission with Synchronous Motors.—A brief discussion of Mr. Picou's paper (see Digest, March 30), by Prof. Blondel, in which he takes exception to a number of points, is published in the "Bul. Soc. Int. des Elec." for April; among other things he states that the effect on the generators, of the current whose phase has been shifted, should be taken into consideration; "for an equal current the fall of voltage is considerably increased by the phase shifting and can exceed the limits of excitation used during normal running." Mr. Picou replied briefly stating that he believes the solutions of the problems which he gave are sufficiently approximate.

Electric Heating.—In a short article by Mr. Dowsing in the Lond. "Elec. Rev.," May 10, he refers to some recent criticisms of Mr. Crompton's paper in the "Gas World" and calls attention to the exhaustive tests made a number of years ago by Mr. D. Kinnear Clark which showed that the average efficiency of the close gas cooking stove is 16 per cent. He claims that the electric system of heating should be compared only with the hot water systems and not with the hot air system, which is not in favor in Great Britain; with the hot water systems which are uneconomical and expensive to maintain, he believes the electric system able to compete, and states that it is believed by many heating engineers that electricity will very shortly prove to be cheaper than all hot water systems; many churches are now considering the introduction of electricity for heating purposes, and if the cost of installing the new system is more—although it is usually about the same—the saving o labor and the ease of regulation will more than compensate for the difference.

Hydro-Electrothermic System.—A detailed description of this system, known abroad as the Hoho and Lagrange and in this country as the Water-pail Forge system of heating, is begun in "L'Eclairage Elec.," April 27, by Mr. Gooch. The present portion contains little that has not already appeared in the frequent references in these columns; he states that practice has shown that the best voltage to use is in general 125 to 200; a power of 35 to 40 kw during 30 to 50 seconds will readily bring the two ends of a bar of iron 4 cm (about 1.5 in.) in diameter to a welding temperature and will heat a surface of about 50 to 60 sq. cm (about 8 or 9 sq. in.) during the same time (but to what temperature is not stated).

Welding.—An abstract of Mr. Foster's recent paper (see Digest, March 9 and 16), is given in Lond. "Engineering," May 10.

Development of the Experimental Study of Heat Engines.—A reprint of a lecture by Prof. Unwin on this subject is begun in the Lond. "Elec.," May 10; it is discussed in the leading editorial.

Recent Developments of the Single Acting High Speed Engines for Central Station Work.—A reprint of an Institution paper by Mr. Robinson is begun in the Lond. "Elec. Eng.," May 10.

Long Distance Transmission.—A paper by Mr. Venable, read at a recent meeting of the Engineers' Club of Cincinnati, is published by

that club; after an introduction to the subject of electrical transmission of power, he describes and discusses the various systems, their advantages and disadvantages.

Electric Power in a Quarry.—A translation of the article mentioned in the Digest, May 4, is reprinted in abstract with the illustrations in the "West. Elec.," May 18.

Electric Plowing.—A brief description of a plant in Germany is given in the "West. Elec.," May 18; it appears to be the same plant of which a brief description was given in the Digest, Dec. 15.

Thawing by Electricity.—The brief article mentioned in the Digest, March 16, is reprinted in the "West. Elec.," May 25.

TRACTION.

Accumulator Traction.—The "Bul. Soc. Int. des Elec." for April contains a paper of some length by Mr. Sarcia (a brief extract of which was given in the Digest, May 11), describing in detail the accumulator system which has been in use in Paris for nearly three years and mentions some improvements which are being introduced. The number of car kilometres which have been run on this line up to date is over 2,000,000; the accumulators used are those known as the Laurent-Cely (known in this country as the Chloride Accumulators); the battery is placed below the seats and consists of 108 cells of 11 plates each; the weight of the plates of a cell is 18 kg (about 40 pounds); it requires five hours to charge a battery which has been completely discharged; the discharge capacity is 230 ampere-hours or 52 hp-hours; the efficiency of the batteries in watt-hours is 70 per cent.; the mean current during the trips is 35 amperes which sometimes increases to 120 amperes; a battery can run with one discharge a distance of 60 km on the Broca rail and 120 on the Vignole rail; the motors are ordinarily in series but can be connected in parallel; for every car there are two sets of batteries; one charge will run two complete trips corresponding to a length of about 50 km; the time of one trip is 55 minutes; the weight of the complete car is 14,000 kg of which 3,000 are batteries and accessories and 3,500 are passengers; the mean traction effort is 12 kg per ton on the Broca rail and six on the Vignole rail; the means, per car kilometre, for two years are as follows: 1.38 hp-hours generated at the station, 3.90 ampere-hours of charge, 2,465 kg of coal consumed and 0.0039 kg. of oil; these figures are given for every month, in a table; the mean cost per car kilometre for maintaining and handling the accumulators is 16 centimes (one centime equals 0.2 cents), motive power 18, maintenance of trucks and motors 5, motormen 8, total 47; of the first item 10 is for maintenance and six for handling. He describes improvements which are being introduced; instead of 12 boxes of accumulators placed under the seats they will hereafter use one large box suspended below the car between the trucks which very greatly reduces the expense of handling; the positive plates had a life of 14,000 car-kilometres, the active material by that time having dropped out; in the new forms these plates will be made like the original Faure plates consisting of a vertical plate having inclined troughs on its surface into which the active material is placed in the form of a paste; after 14,000 car-kilometres the material has left its support and the plates are then removed and the material again introduced in the form of a paste, after which operation the plates are nearly as good as new; the frames may thus be repasted 10 times before they are completely destroyed; the minimum life of these new plates is said to be 100,000 car-kilometres; they will also stand a greater rate of discharge and therefore the batteries may be reduced to 56 cells of nine plates with a total weight of plates of 1,700 kg, that of the former battery being 3,000; the cost of maintenance and handling is thereby reduced 40 per cent.; the total weight of the new car including batteries and passengers is 11.7 tons, that of the former car being 14.5 tons; the new car requires only 70 per cent. of the power used by the old form and the maintenance of the trucks and motors is reduced to three centimes, making a total of 34 as against 47 centimes, a reduction of 30 per cent. which is said to be lower than the cost of any mechanical system of traction known except that of the overhead trolley system. "L'Energie Elec.," May 1, publishes a long, illustrated description of the same system, giving practically the same data with some additional matter, including quite a number of illustrations. Single reduction motors are used with a reduction of 5 to 1; each motor generates 10 kw at 600 revolutions with 100 volts. Two diagrams are given showing the energy consumed in mounting a grade and that returned to the battery on descending the grade; in one case the former was 976.5 watt-hours and the latter 385.0 and in another case the former was 625.8 and the latter 216.0.

Chasseral Mountain Road.—The "Rev. de L'Elec.," April 30, contains a brief description of a projected road on Mt. Chasseral in the Jura Mountains. The total length is about 7 km; the chief conditions were that it should be able to transport a large number of visitors on holidays and should be cheap, also that the service should not be interrupted by the large amount of snow which falls in winter, during which season the view from that mountain is particularly attractive. The car is suspended from a single overhead rail at various heights above the ground depending upon the contour of the surface; the pillars "also support frames between which the cars run"; the cars are long and will hold 24 passengers; the ascent will be made in three quarters of an hour at the rate of 6.2 miles per hour; it appears that it is an adhesion road and it is intimated that it ought to have been a rack road in order to permit of an increased speed; the maximum rate is 24 per cent.; the rise is 730 metres and the total length 6,800 metres. It appears that the motor is a gearless one being connected directly to the driving wheel; it is suspended in a fork connected to the car by springs; the current seems to be taken from a rod above the car and returns through the rail; the cost is said to be 82,000 fr. per km (equal to about $27,300 per mile); the current will be generated by water power. Nothing further is given in the description.

Surface Contact System.—"L'Eclairage Elec.," May 4, contains a long article forming the first part of a description of the Claret and Vuilleumie system (see Digest, May 18).

Dublin.—A brief description of this trolley road, built by the British Thomson-Houston Company, is given in Lond. "Engineering," May 10.

Accumulator Traction in Berlin.—A brief description with some illustrations of the controller connection, is published in "Elec. Eng.," May 22. It is an experimental line 3.5 miles in length, mostly level, on which two cars are run, provided with Tudor accumulators; a car makes two trips, covering a distance of 16.25 miles in three hours and 25 minutes; six sets of batteries are used for the two cars, each being grouped in four series of 22 cells, which are variously connected by the controller, the combinations being shown in the illustration; the weight of the car is nine tons without the passengers, the batteries weighing 3.3 tons; the capacity is 130 ampere-hours; for each car mile 1,050 to 1,100 watt-hours are required; only 56 per cent. of the total capacity of the battery is drawn on.

Operating Expenses of New Haven Roads.—The coal consumption and earnings of the New Haven street railways are given briefly in the "St. Ry. Gaz.," May 18, showing that the increasing gross earnings are accompanied by decreasing operating expense; in the year ending in April, 1894, the consumption was 7.26 pounds per car mile and in the year after, 4.75; the total cost of the station for the first 13 weeks of 1894 was 2.26 cts. per car mile and during the corresponding period of 1895 1.84 cts.

Liverpool Elevated Railway.—A detailed list of the costs per train mile for the last six months of the past year are given in the "St. Ry. Rev.," May 15; the total cost was 25.935 cts. per train mile; the portion for motive power including repairs of motors was 6.430; the largest item was for traffic expenses, 10.185.

High Speed Electric Line.—According to a statement in the "Elec. Eng.," May 22, a railway is to be built from Lorain to Cleveland, a distance of about 25 miles, which is intended to be the fastest electric railway in the world; the distance will be traveled in a little over half an hour.

Rapid Transit in New York City.—The statements of the Commission, accompanying the plans which were submitted to the Common Council, are given in "Eng. News," May 16, and more briefly in the "Elec. Age," May 18.

European Railway Motors.—A brief, illustrated description of the Thury (Swiss) motor, which is to be used on the Geneva railway, is given in the "St. Ry. Gaz.," May 18. A brief, illustrated description of the motors made by the General Electric Company of Berlin is given in the "St. Ry. Rev.," May 15.

Metropolitan West Side Elevated Railway of Chicago.—A long and profusely illustrated description of this road is published in the "St. Ry. Rev.," May 15. A brief description is given in the "Elec. Eng.," May 22.

Inclined Railway at Great Falls, Mont.—A brief, illustrated description is given in the "St. Ry. Rev.," May 15.

Mining Railway in France.—A brief description, including a plan and elevation of the conductor rail, of the plant mentioned in the Digest, May 18, is published in "Eng. News," May 16.

Geneva.—A brief illustrated description of this road is given in the "St. Ry. Rev.," May 15.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Brighton.—The Lond. "Elec. Eng.," May 10, reprints a paper by Mr. Wright on "Points of Interest in the Development of Electricity Supply at Brighton." He gives a brief history showing that the city of Brighton was the leader in certain features in electric supply in England; in the latest extension in 1894 the unique system was adopted of supplying electricity at light loads by the continuous current and at heavy loads through the medium of high tension alternating feeders. A table is given showing the cost per kw-hour, exclusive of redemption and interest, for a number of stations in England, from which it appears that that at Brighton, namely, 4.6 cts., is the lowest; the annual sale per inhabitant in a number of towns of over 50,000 inhabitants is given, showing it to be greatest for Brighton, namely, 9.86. He believes that it is not sufficiently well recognized that the cost to the stations of continuing to produce electricity after everything has been put in a state of readiness to do so, constitutes an extremely small proportion of the total expenditure; from the experience of the last three and a half years

at Brighton, the cost of getting ready to supply electricity in 1895 will probably amount to 80 per cent. of the total annual expenditure; a diagram is given showing how very slightly the total monthly cost of running the station varies as compared with the corresponding sales of the current; from the diagram it appears that the monthly costs vary on the average about one fourth as much as the monthly sales; another conclusion from these curves is that the total monthly expenditure depends much more on the maximum rate of supplying the current than on the actual amount of that which has been supplied. In Brighton the charge is reduced to six cts. as soon as the proper proportion of the cost of having to be ready to supply that individual has been paid by the revenue derived from his previous consumption in the same half year, being charged at 14 cts.; this in the year 1895 happens to be after the use of his greatest demand for one hour per day on the average. Another diagram shows how rapidly the cost of supplying diminishes according to the length of time the demand is used per day; electricity for street lighting, the demand for which averages nearly 11 hours per day, can therefore be supplied at four cts. with a fair margin of profit, and he believes there is no other suitable form of artificial illumination which can compete with electricity at this price. He believes that engineers devote too much of their time to the reduction of running costs and thereby neglect the important question of how to diminish the much greater standing costs.

Parallel Running of Compound-Wound Machines.—In a short article by Mr. Pigg in the Lond. "Elec.," May 10, he describes the system used in the North-Eastern Railway Company's station, which has been very satisfactory and which he thinks is not in use in any other installation. It consists of four over-compounded dynamos directly driven by engines and run in parallel on the bus bars; the only ammeters used are in the lamp circuits and they are not available for ascertaining the loads on the different machines; the shunt regulating resistances all work together, independent control being neither necessary nor possible. There are three ungraduated indicators, each consisting of a polarized needle with a few turns of wire around it, one being connected between the positive brushes of each pair of machines; if a current passes between the two machines part of it passes through the indicator branch deflecting the needle, the latter pointing to the machine which is giving current to the other; the speed of the engine is then increased or diminished until the pointer becomes vertical again; it is necessary, whether the machine is for the same or different outputs, that the resistance of the several machines between the brushes and the bus bars shall vary inversely as their maximum rated current outputs; unless this condition is complied with the total safe working capacity of the plant will be lowered.

Theatre Lighting.—A description of a new lighting plant at the Politeama Florentino, a theatre in Florence, is published in "L'Elettricista," May 1.

Sheffield.—An illustrated description of this alternating-current station is given in the Lond. "Elec.," May 10.

Chemnitz.—An illustrated description of this station is begun in the Lond. "Elec. Rev.," May 10.

Test of a Gas Engine Plant.—The "Eng. News," May 23, abstracts at some length a recent paper by Mr. Burchard on the "Use of Gas Engines to Drive Dynamos at Danbury, Conn." The abstract includes a very complete table of data giving the results of brake tests and another giving the output and fuel consumption of that station for the past six months; during that time the average was at the rate of 159.6 watt-hours per pound of coal after allowing 25 per cent. for fuel used in steam boiler; the average kw-hours per day was 435; producer gas is made on the premises; there are three gas engines of 100 horse-power each; a few indicator cards are given.

Municipal Ownership.—A correspondent to the "Elec. Rev.," May 22, points out certain considerations which he believes are amply sufficient to account for the differences in the conditions in New York City and in Manchester, Eng.; he believes that "private ownership of those functions breeds dishonesty as naturally as filth breeds disease." Every penny paid by citizens over the actual cost is the nucleus of a possible corruption fund and it is that which tempts the City Councils to dishonesty.

Statistics for Germany.—A few of those recently mentioned in these columns are given more in detail in the "Elec. Eng.," May 22.

Fires of Electric Origin.—The "Elec. Age," May 18, reprints in part a description of a recent series of demonstrations of Mr. McDevitt, insurance inspector of Philadelphia, of ignitions from defective and unskilful electric wiring.

Private Plants.—A description of the electrical features in the Carnegie Steel Company's building in Pittsburgh is given, accompanied by a number of illustrations, in the "Elec. Eng.," May 22. A compact gas engine plant in which a new type of gas engine is used, is described and illustrated in the "West. Elec.," May 18; the capacity is 200 incandescent lights. The electric equipment of the Rothschild store in Chicago is described and illustrated in the "West. Elec.," May 25.

Brooklyn.—An illustrated description of the new station of the Citizens' Electric Illuminating Company is published in "Elec. Age," May 18.

WIRES, WIRING AND CONDUITS.

Earthing the Middle Wire.—Mr. Sharp in the Lond. "Elec.," May 10, states that a recent report (see Digest, May 18), leads one to suppose that the middle wire "will be earthed throughout from the central station to all parts of the district, with a considerable loss in the conductor when the current in the two outer cables is not balanced"; he states that this may be overcome by protecting the middle conductor with a slight insulation on the feeders and also on the distributing network, earthing it, not at the station but only at the points where the feeders "are connected to it" (presumably to the distributing network), from where the pilot wires are carried back to the station; there can then be no difference of potential between these earthed feeding points and no injury from electrolytic action or disturbance of telegraphs and telephones will occur. He recommends the use of concentric cables with the outer conductor earthed at these points, the sheathing of the cable forming the middle conductor and being slightly insulated; he believes that this method will be largely used in the future.

ELECTRO-PHYSICS AND MAGNETISM.

Representation of Periodic Currents by Polar Diagrams.—The Lond. "Elec.," May 10, contains a short paper by Dr. Fleming on this subject in which he shows that the polar diagram is specially applicable to graphically representing simple periodic currents. In such a diagram the length of a line drawn in various positions from a common centre, represents the value of the current or the E. M. F., and the angle which it makes with the horizontal line represents the phase; a polar diagram of a simple periodic current will then be a circle tangent to the horizontal line at the point to which all the lines are drawn. Such a diagram enables one to determine very easily the square root of the mean square value of the periodic quantity; it is more difficult to do this with the ordinary wave curve diagram. This he illustrates with an example; the rule is to construct the polar diagram, which is always a closed curve, then take the area of it by means of a planimeter and then find the circle whose area is double this; the radius of this circle is the square root of the mean of the squares of the periodic quantity. The article is commented on favorably in an editorial in which it is stated that the ordinary sine curve is in these diagrams replaced by a circle, and two sine curves separated by a difference of phase become two circles intersecting at the phase angle; it suggests that some of the properties of alternating currents usually demonstrated by means of sine curve might be more easily proved by means of circles. On account of the undoubted advantages of polar diagrams it suggests that printed polar paper might be made, to be used in place of the cross-section paper, the polar paper having a pole in the middle, radial lines and a succession of thick and thin concentric circles.

Alternating and Interrupted Currents.—The beginning of Prof. Forbes' second lecture is published in the Lond. "Elec. Eng.," May 10. He gave a further description of his analogy showing what goes on in an Atlantic cable and discusses more at length the subject of induction which he compares to mechanical momentum. He gives an example of analogies of electric units which are below under "Units, Measurements, etc." The Lond. "Elec.," May 10, refers briefly in an editorial to the concluding lecture describing an experiment which was shown and which is not well known, relating to the mechanical effect of high voltage direct currents on a piece of wetted thread connecting two vessels of water; the passage of the current causes the thread to move bodily in the reverse direction of the current, while the water moves in the same direction as the current (the experiment, due to Lord Armstrong, was described in the Digest, March 18, 1893); he suggested that there may be a germ of a useful electrical instrument in this phenomenon.

Curious Vacuum Tube Phenomena.—Mr. Lomas in the Lond. "Elec.," May 10, describes the following experiments: after glowing a vacuum tube with an influence machine and after removing the tube even so far as to another room, it will still continue to glow for one or two minutes; in some cases the tube appeared dead but on placing the hand directly around the central bulb a sudden glow shot through the tube which could be repeated by removing the hand to a different position. The tube was held in the hand and one extremity connected with the machine, then after stopping the machine and touching either extremity with the other hand a sharp shock is felt; the effects are exceedingly beautiful in a dark room; he sometimes noticed a small cloudy film of light swirling around the inside of the centre bulb accompanied by crackling sounds. He believes that the cause of the phenomena is that the glass tube acts in the same way as a dielectric. In commenting on this editorially it is stated that the tube probably acts as condenser, but it is difficult to see how such small tubes can have enough capacity to give such sharp shocks; the effects are quite distinct from the Tesla effects which occur when the tube is placed in a potential gradient or in an externally excited field.

Double Electric Film.—"L'Eclairage Elec.," May 4, contains an illustrated article of some length by Mr. Brunhes in which he describes

new researches with the double electric film (called by Helmholtz "Elektrische Doppelschicht") which existed on the opposite sides and surfaces separating two different bodies, either conductors, electrolytes or dielectrics. Under certain circumstances this double layer is reduced to zero and the condenser formed by the two surfaces is completely discharged; if then an alternating E. M. F. is applied the conditions will be similar to those in an idiostatic electrometer, like the absolute electrometer of Kelvin; before describing this in detail he gives a summary of the principal researches which show the existence of such double layers. A brief abstract of his recent Academy paper on the same subject is given in the Lond. "Proc. Phys. Soc." for May.

Specific Heat and Boiling Point of Carbon.—An Academy paper by Mr. Violle mentioned in "L'Elec.," May 11, contains the following results of his researches: below 1,000° C. the mean specific heat of graphite increases in a linear proportion with the temperature; the heat given off by one grain of solid graphite falling from the temperature of volatilization to 0° C. is 2,050 calories, the boiling temperature of carbon is 3,600° C.

Passage of an Oscillator Wave Train through a Plate of Conducting Dielectric.—The Physical Society paper by Mr. Yule, mentioned in the Digest, Feb. 9, is published in full in the Lond. "Proc. Phys. Soc." for May.

Waves and Vibrations.—The concluding lecture of Lord Rayleigh is abstracted in the Lond. "Elec. Rev.," May 10; no reference seems to be made to electric waves.

Refraction and Dispersion of Electric Rays.—A translation from the Italian, of an article by Messrs. Garbarso and Aschkinass is given in abstract in "L'Eclairage Elec.," April 27.

Potential Gradient in a Positive Glow Discharge.—The article by Mr. Herz, mentioned in the Digest, April 20, is abstracted in the Lond. "Proc. Phys. Soc." for May.

Resistance of Solutions.—A paper by Messrs. Kohlrausch and Heydweiller from the "Wied. Ann.," 54, p. 38, is published in the Lond. "Proc. Phys. Soc." for May; they show that the resistance of aqueous solutions and of distilled water decreases when a current passes, beginning a few seconds after the current is started and rising again two or three minutes later; for pure water the decrease is nearly 50 per cent.; an explanation is offered.

Electrical Conduction and Convection in Slightly Conducting Dilute Solutions.—The Lond. "Proc. Phys. Soc." contains an abstract of a paper by Mr. Warburg from the "Wied. Ann." 54, p. 396.

Loss of Charge of Poor Conductors When Illuminated.—An Academy paper of Mr. Branly is abstracted at some length in "L'Eclairage Elec.," April 27; it gives the results of observations of the loss of an electric charge on materials like wood, marble, heated glass, etc., under the action of light.

Photo-Electric Currents.—An article from the German by Messrs. Elster and Geitel is abstracted briefly in the Lond. "Proc. Phys. Soc." for May; when a beam of light falls on the surface of a cathode in a vacuum tube connected with a battery of about 420 volts, a current passes whose strength varies with the angle of incidence and with the plane of polarization of the light.

Contact Resistance of Metals.—A long abstract of Mr. Branly's paper, mentioned in the Digest last week, is published in "L'Eclairage Elec.," May 4.

Electrical Conduction of Rarefied Air.—An article by Mr. Mebius from the "Wied. Ann.," 54, p. 520, is abstracted briefly in the Lond. "Proc. Phys. Soc." for May.

Potential of an Electrified Surface.—A brief abstract of a French Academy paper by Mr. Andrade is given in Lond. "Proc. Phys. Soc." for May.

Electrification of Air.—A paper read before the Philosophical Society of Glasgow by Lord Kelvin is abstracted at some length in the Lond. "Elec.," May 10; he describes some experiments.

Terrestrial Magnetism.—"L'Eclairage Elec.," April 27, abstracts briefly an Academy paper by Gen. Tillo on the variations of the earth's magnetism, in which he gives the values of the declination and the inclination for 504 locations.

Magneto-optic Effect.—The Lond. "Proc. Phys. Soc." for May contains an abstract of some length of an article from the German by Mr. Wind on the Kerr effect.

Poisson's Ratio in Magnetized Iron Rods.—A paper by Mr. Bock from the "Wied. Ann.," 54, p. 442, is abstracted in the Lond. "Proc. Phys. Soc." for May.

The Effect of Light on an Electric Charge.—The article from the French by Mr. Branly, mentioned above, is abstracted briefly in the "Elec. Eng.," May 22.

ELECTRO-CHEMISTRY AND BATTERIES.

Internal Resistance of Accumulators.—The "Zeit. f. Electrochem.," May 5, contains an article by Dr. Shoop giving the results of measurements of the internal resistance of accumulators at different times during the discharge; he was lead to these tests by noticing, in a test of a series of accumulators, that the internal resistance during the discharge was only about one third of that measured on open circuit. In the present tests the internal resistance was calculated from the fall of voltage during the discharge, the voltage being measured while the current was flowing and again immediately after opening the circuit; the accumulators were discharged at two different rates, one about double the other, and the resistance calculated for successive fractional discharges; the results show that the resistance is lowest when the cell is about half discharged, after which it increases and reaches about 17 times the minimum value; owing to the methods of measurement, however, the results are not quite correct.

Antimony Accumulator.—The "Elek. Anz.," May 9, abstracts from a recent patent of Mr. Darrieus, a description of an accumulator in which the negative plates are made of spongy antimony and the positive either of peroxide of lead or of oxidized antimony, the electrolyte being dilute sulphuric acid; the advantages of antimony are said to be that the weight is less, that no sulphate is formed on the negative plates due to local action and that the mechanical strength is greater (the voltage of the cell is not given); the greater part of the description is devoted to various methods by means of which the antimony plates may be prepared.

Electrostriction by Free Ions.—An abstract of an article by Messrs. Drude and Nernst from the "Zeit. Phys. Chem.," 15, p 79, is published in the Lond. "Proc. Phys. Soc." for May.

Potential Difference between Metals and Electrolytes.—An article by Mr. Rothmund from the "Zeit. Phys. Chem.," 15, p. 1, is abstracted in the Lond. "Proc. Phys. Soc." for May.

Theory of Electrolytic Dissociation.—An article by Mr. Tanatar from the "Zeit. Phys. Chem.," 15, p. 117, is abstracted in the Lond. "Proc. Phys. Soc." for May.

Solubility and Electrolytic Dissociation.—An article by Messrs. Noyes and Abbot from the "Zeit. Phys. Chem.," 16, p. 125, is abstracted in the Lond. "Proc. Phys. Soc." for May.

Molecular Conductivities.—The Lond. "Elec. Rev.," May 10, calls attention to a paper by Messrs. Werner and Miolati from the "Zeit. f. Phys. Chem.," 14, p. 506, in which they give the conductivities of a large number of compounds and the results of their system of elucidating chemical constitution by molecular conductivity determinations.

Galvanoplastics.—Some recent improvements are summarized briefly in "La Nature," May 11, including an electrochemical process for plating metals with platinum.

Applications of the Electric Furnace for Metallurgical Purposes.—The recent paper by Mr. Moissan, mentioned in the Digest last week, is published in full in "L'Eclairage Elec.," April 27.

Books on Electrolysis.—In answer to an inquiry regarding a selection of books on this subject, the Lond. "Elec. Rev.," May 10, gives the following list: Sprague's "Electricity"; Gore on "Electro-metallurgy," and the "Art of Electrolytic Separation of Metals"; the works of Watts; in French, Fontaine's "Electrolyse"; Tommasi's works; Cadiat and Dubost on "Electricité Industrielle"; and in general the technical press.

Refining Zinc by Electrolysis.—Mr. Richards, according to the "Elec. Age," May 18, refines impure zinc by electrolysis; the current density is 100 amperes per square metre and the voltage 1.3 per bath; the solution is kept agitated by mechanical means; thick deposits of zinc of exceptional purity can thus be obtained; the accumulation of iron in the solution is prevented by blowing air through it continually, which oxidizes and precipitates the iron; the process could be operated commercially if it were not for the very low price of zinc, the margin of profit being less than in refining copper, while the expenses are greater.

Thermo-chemical Carbon Battery.—Dr. Huber, in the "Elec. Eng.," May 22, states that about 18 months ago he made practically the same experiments as were recently described by Mr. Korda (see Digest, May 4 and 11); with an area of about two square inches, using peroxide of barium between two ordinary battery carbons, a current of 0.2 amperes and 1 volt were generated; the constancy of the cell is said to be excellent and the consumption of bar peroxide not excessive.

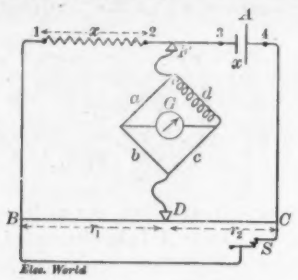
Limits of Electrolysis.—An abstract of the paper of Mr. LeBlanc, abstracted in the Digest, Dec. 29, is published in the "Eng. & Min. Jour.," May 18.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Effects of Railway Currents on Measuring Instruments.—The "Elek. Zeit.," May 9, contains a long article by Mr. Voller discussing the subject of the effect of electric railway currents on magnetic and electric measuring instruments, and the prevention of these effects. He describes very extended researches which were made in the city of Hamburg for determining the location of a laboratory; a photographic registering apparatus was used, some of the records of which are reproduced and discussed in detail. He believes it can be considered proved that the disturbances are due almost entirely to the earth return currents and very slightly only to the inductive action of the currents in the lines and car. The conclusions of his researches are as follows: the usual mirror instruments cannot be used for accurate measurements within

distances to an electric railway up to several hundred metres, especially if located at points within a railway line making a complete circuit with the power house near the centre; that merely enclosing a mirror galvanometer with an iron ring or its equivalent will by no means protect those instruments completely from disturbances caused by electric railways; that the disturbances may be made negligibly small although at the expense of the sensitiveness of the instrument, by use of an independent magnetic field inside of an iron shield surrounding the instrument, or by the use of strong permanent magnetic fields without the iron shield; instrument makers should therefore give special attention to constructing instruments having a strong permanent magnetic field combined with as great sensitiveness as possible; such galvanometers may be calibrated by means of a voltameter or with the use of a standard cell and a known resistance; the determination of the horizontal component of the earth is therefore no longer of such importance; observations of the earth's magnetism can in the future no longer be made within the range of an electric railway except during the night.

New Method for Measuring Internal Resistance of Accumulators.—A new method is described by Prof. Grassi in "L'Elettricista," May 1. It consists of a combination of Mance's improved method and those of Hopkin and Matthiessen. Referring to the accompanying figure, *A*



Elec. World

is the accumulator having an internal resistance x; a, b, c and d are four resistances, d being highly inductive, they being so proportioned that $b\,d = a\,c$; G is a galvanometer, r a standard resistance, $B\,C$ a calibrated stretched wire and D a sliding contact; the position of D is adjusted until the galvanometer remains at zero when the switch S is opened and closed; the same operation is then repeated only F is placed successively at the points *1*, *2*, *3* and *4* and if e, f, g and h are then the four readings on the calibrated wire $B\,C$, the resistance x of the battery is given by the formula $X = r\,\frac{h-g}{f-e}$.

Optical Method for Studying Alternating Currents.—An Academy paper by Mr. Pionchon is abstracted in "L'Eclairage Elec.," May 4, and "L'Elec.," May 11. Between the polarizer and the analyzer of a saccharometer a solenoid is placed encircling a glass tube filled with Thoulet solution; in connection with this the so-called stroboscopic method is used, the speed of vibration of which is slightly different from that corresponding to the frequency of the alternating current and it can therefore be adjusted so that the different phases of the phenomenon are made to appear to follow each other as slowly as one desires; the method is not only qualitative but enables measurements to be taken, which he describes briefly.

Induction Tests with Telephone and Bridge.—An article by Mr. Abraham from "Jour. Phys.," 4, p. 127, is abstracted in the Lond. "Proc. Phys. Soc." for May.

Analogies of Electric Units.—In a recent lecture by Prof. Forbes, mentioned above, he makes the following analogies: he assumes one volt to mean 1 oz. driving at a radius of 1 in., and one ampere one revolution per second; a coulomb is equivalent to one revolution; there is a farad when it makes one revolution with 1 oz. of pressure and a henry if there is a current of one ampere, gradually reducing during one second by its own self-induction to zero; the pressure that is in that interval of time being constantly exerted is the equivalent of one volt and that is obtained by the momentum of a cylinder of 1 in. radius weighing 62 oz.

Lecture and Laboratory Apparatus and Methods.—The "Zeit. f. Electrochem.," May 5, contains a continuation of the article by Dr. Borchers which was begun in that journal last year; he discusses methods for producing lithium and beryllium, and an apparatus for the electrolysis of fused substances.

Aperiodic Electrometer Free from Magnets and Elastic Fatigue.—A paper by Mr. Hallwachs describing a somewhat complicated quadrant electrometer is abstracted very briefly in the Lond. "Proc. Phys. Soc." for May.

Aperiodic Volt and Ampere Meters.—A long description of the new instrument of Messrs. Arnoux and Chauvin, described in the Digest, May 11, is published in "Bul. Soc. Int. des Elec." for April; a reprint of the whole paper is begun in "L'Elec.," May 11.

Construction and Use of Electrical Measuring Instruments.—A serial by Mr. Yeaman is continued in the successive issues of Lond. "El'ty"; in the issue of May 10 he gives a recapitulation of the simple formulas of the various quantities involved in the calculation of alternating currents.

Lecture Apparatus for Showing Resonance.—A mechanical device is described by Mr. Guillaume in "La Nature," May 11, the description being accompanied by a good illustration.

TELEGRAPHY, TELEPHONY AND SIGNALS.

World's Telegraphs.—The Lond. "Elec. Rev.," May 10, abstracts briefly statistics for Great Britain, Russia and the United States from the "Jour. Teleg.," Nov. 25.

Telegraphing Without Wires.—A recent paper by Mr. Wietz is abstracted briefly in the "Bul. Soc. Int. des Elec." for April. He gives a review of the subject covering the past 10 years.

Regulator for the Hughes Apparatus.—Two new forms, which are claimed to be improvements on those formerly used, for regulating the speed of the moving part of a Hughes telegraph apparatus, are described and illustrated in the "Elek. Zeit.," May 9.

Madagascar Cable.—A short article from the French is reprinted in the Lond. "Elec.," May 10.

Submarine Cable Work.—In Mr. Wilkinson's serial in the Lond. "Elec.," May 10, he discusses cable currents and balancing to false zero.

Practical Telephony.—Lond. "El'ty" is publishing a serial on "Practical Telephony" by Messrs. Bell and Wilson; it is written in an easily understood style and appears to contain some good matter.

Microphone.—The Mix & Genest microphone for domestic systems, in which grains of carbon are used, is described and illustrated in the "Elek. Zeit.," May 9.

Accumulators for Telegraphic Purposes.—Directions for installing and maintaining such batteries are given in an illustrated article by Mr. Hofmeister, of Germany, begun in the "Elec. Rev.," May 22.

Muench Telephone Coil.—The one described in the Digest, May 18, is illustrated and described more fully in the "Elec. Eng.," May 22.

Telephone Companies.—The "West. Elec.," May 18, contains several short articles referring chiefly to western companies; it also contains an account of the annual meeting of the New England Telephone & Telegraph Company.

Berliner Telephone Patent.—The "Elec. Rev.," May 22, publishes the full text of the American patent.

Sub-Master Clocks.—The system used in the Western Union time service is described and illustrated in the "Teleg. Age," May 16.

Vibrating Bell for Testing.—A device used by the Western Union Company is illustrated and described briefly in the "Teleg. Age," May 16.

MISCELLANEOUS.

Protection by Lightning Rods.—The "Elec. Tech.," April 15, contains a short article by Dr. Neumann in which he shows, by referring to a number of cases, that it is not correct to state that a certain area will be completely protected against lightning by a lightning rod at its centre; the real function of the lightning rod is not to form a path for a bolt of lightning, but to equalize gradually the difference in charge between the earth and the clouds, by virtue of the points on the rod; he offers proofs of the correctness of this explanation by citing several cases in which the erection of lightning rods in a town and in a city was followed by an absence of bolts of lightning which were formerly frequent and which still occurred in the neighboring districts; an experiment illustrating this action is described.

Carbide of Aluminium.—According to the Lond. "Elec. Rev.," May 10, Mr. Moissan has recently produced a crystalline carbide of aluminium by submitting aluminium, in carbon cells placed in carbon tubes in the furnace, to a current of 300 amperes at 65 volts, passing hydrogen gas through the tube during the operation and until the apparatus became cold; the gray mass contains brilliant yellow crystals of this material.

Ozone Generators.—Several forms taken from recent English patents are described and illustrated in "Zeit. f. Electrochem.," May 5.

Automatic Electric Clock.—The French system is described and illustrated at some length in "L'Elec.," May 11.

Disintegration of Animal Tissue by High Voltage Faradic Currents.—In a recent paper by Mr. Parsons, abstracted in the "Rev. Int. d'Electrotheraphie" for March he describes experiments made on fresh beef in order to study the use of electricity for the treatment of malignant tumors; he shows that the destructive action of such currents is not limited to the direct neighborhood of the poles but extends a certain distance from them; the muscular fibres are torn by the action of the current but there is no sign of any thermic caustic action. Mr. Jones believed that the action was simply one of heat and that the treatment of tumors by this method would lead to gangrene; the author replied that he used induced currents of high voltage which had practically no thermic effect.

Physiological Action of High Frequency High Tension Currents.—An article by Dr. Sletoff from the Russian, is translated in the "Rev. Int. d'Electrotheraphie" for March; he gives a review of the subject and

describes experiments made on patients with his apparatus, which consists of a Leyden jar charged by an induction coil, the discharging currents of the jar being transformed up by means of a transformer.

Electrotherapy.—The Lond. "Elec Eng.," May 10, abstracts briefly an article by Dr. Hedley from the "Lance" giving a history of what has been done and what is being done and concluding that the field of electrotherapy seems to be broadening.

Electro-culture.—Some recent experiments of Mr. Lœhnenschloss with an apparatus resembling the geomagnetifère are briefly described in the "Rev. Int. d'Electrotheraphie" for March.

New Journal.—A new monthly journal is being published by Hachmeister & Thal, Leipsig, Germany, called "Literarischer Monatsbericht." Its object is to give notices, reviews and lists of new books on architecture, engineering and electricity; the price is 2 M. 50 Pfg. (about 64 cents per year.)

Applications of a Heated Wire.—Mr. Knowles, in the "Elec. Eng.," May 22, in referring to the recent article of Mr. Irish, abstracted in the Digest, May 18, states that there must be reasons why this simple device has not come into more extended use; he believes that it is because the action is too sluggish, that it is difficult to compensate the different room temperatures, and that a physical change takes place in wires under the combined action of strain and heat.

Magnetization of Steam Railway Signals from Street Railway Currents.—A peculiar case is described by Mr. Wellman in the "St. Ry. Gaz.," May 18, in which the signal levers in a switch house at the crossing of an electric line over the tracks of the steam road, were magnetized continually and with varying intensities.

Recent Advances in American Electrical Work.—The portion of the report of the Secretary of the Franklin Institute referring to electrical work, which was mentioned in the Digest, Feb. 16, is reprinted in full in the "West. Elec.," May 18; the original will be found in "Jour. Frank. Inst.," for February.

Carbide and Acetylene.—The lecture abstracted in the Digest, May 18, is reprinted in full with the illustrations in the "West. Elec.," May 18.

Biographical.—Brief biographical sketches, with portraits of the new officers of the American Institute of Electrical Engineers, are published in the "West. Elec.," May 25.

New Book.

STANDARD WIRING FOR ELECTRIC LIGHT AND POWER. By H. C. Cushing, Jr. 84 pages, illustrated. Price, $1.

In the preface the author states that one of his objects in compiling the present work is to "standardize, as much as possible," all work relating to exterior and interior electric light and power wiring. Upon opening the book casually the first illustration that caught our eye was of Dr. Gibbon's resuscitating bellows, and the accompanying text shows that apparently the author has accepted, in all seriousness, the Syracuse doctor as an authority on the subject of resuscitation from electric shock. This was not very reassuring, but an examination of the other pages of the book, while it did not by any means justify the claim of authority implied in the preface, yet left the conviction that the book is one that will prove very useful to the wireman.

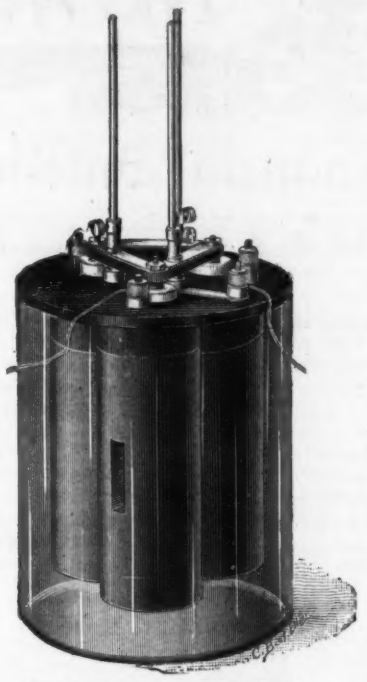
The author, who is an insurance inspector, has taken the rules of the Underwriters' National Electrical Association as a basis and added notes to show how they should be applied, that work may be most likely to meet with approval from insurance inspectors. Some tables are included and a number of illustrations from various sources of "standard" fittings, and of methods of construction work with reference to pole lines, installing up transformers, etc. A chapter on miscellaneous matter gives definitions of the electrical units (but with the henry omitted and the old and incorrect value of the ohm given), some remarks on the efficiency of the incandescent lamp and Ohm's law, and a number of mechanical formulas. To those desiring an interpretation of insurance rules on the authority of an insurance inspector this work will prove of value.

A Five-Volt Multiple Battery.

Numerous unsuccessful attempts have been made to increase the E. M. F. obtainable from a single cell of battery, hence it would seem that a real step forward has been made by Mr. E. G. Boynton, whose 5-volt battery we illustrate herewith. The battery is manufactured by the Boynton Multivolt Battery Company, 10 and 12 Whipple Street, Brooklyn, and consists practically of three carbon-zinc couples connected in series but occupying a single jar and using a single electrolyte in common. The carbon elements are cylindrical and covered on the outside by an insulating material which prevents cross-flow from one carbon cylinder to another, compelling the current to follow the path afforded by the conducting strips on the cover of the jar, which connect the couples in series.

The zinc rods and jars are the ordinary commercial articles, and have no special features. The jars are 6 x 8 inches; regular "crow-foot" size.

The cylinders are perforated on one side to allow the passage of the electrolyte, and these perforations are turned radially outward, next the side of the jar, so as to make the distances as great as possible between these, the uninsulated part of the carbon cylinders. The cut shows the perforations to be long rectangular slots, but in the latest form of this battery the cylinders are perforated with a vertical row of round holes, four of them being close together near the bottom and one



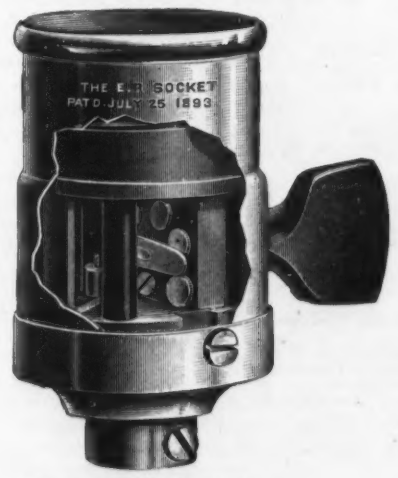
MULTIVOLT BATTERY CELL.

somewhat isolated from these and near the top. This arrangement is an important one, the result being a constant circulation of the fluid when the battery is in action. As the electrolyte inside the carbon cylinder becomes warm it rises and escapes through the upper hole and cool fluid flows in through the lower holes. The warm fluid upon escaping from the cylinder is provided with an ample radiating medium in the side of the jar, so that even under prolonged short-circuit the temperature of the cell does not rise to an uncomfortable point.

Readings taken with Weston instruments show that under a short-circuit of half an hour one of these cells gives an initial current of 12 amperes, which falls to five amperes during the first two minutes of the short circuit, after which the current is maintained at five amperes. The normal output of a three-element cell is two to three amperes at five volts. The zincs can be raised to reduce the activity of the cell.

A Regulating Lamp Socket.

The accompanying illustration shows a new regulating socket known as the "Economic," which is being marketed by The Electric Company, 56 Broadway, New York. The makers claim a diminution of current as



REGULATING SOCKET.

the light is decreased, though the values are not proportionate. As will be noticed upon an inspection of the engraving, the socket is quite compactly made and does not differ in outward appearance from the ordinary keysocket.

These sockets are equally efficient on both alternating and continuous current circuits, and are at present furnished for use with 100 to 118-volt lamps. Sockets will shortly be manufactured for 50 to 55-volt circuits.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, May 25, 1895.

THE ELECTRICAL LIST displayed no particular activity this week, outside of American Bell. Western Union and the Tractions remained firm, while General Electric and Westinghouse showed slight reaction.

AMERICAN BELL opened strong on Monday, as was expected, but did not reach as high a point as its friends anticipated, to-day's closing figure being about the best of the week. The fact is that prior to last week's decision the stock had advanced upon the strength of increasing output and the failure of alleged competitors to enter into active work, so that there was not a great margin of sound advance left.

BALTIMORE TRACTION'S firmness continues to attract attention, and it seems to be the consensus of opinion on the Philadelphia floor that there is something more than talk in the consolidation rumors flying around.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Chicago Edison Company	100	120	125
Edison Electric Ill., New York	100	99	100
" " " Brooklyn	100	..	108
" " " Boston	100	129	130
" " " Philadelphia	100	..	115
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	..	28⅛
General Electric	100	33	33⅛
General Electric, pref	100	..	65
Westinghouse Consolidated, com.	50	33½	33¾
" " pref	50	52	52½

BONDS.

Edison Electric Ill., New York	100	105⅛	105½
Edison Electric Light of Europe	100	75	85
General Electric Co. deb. 5s	100	..	90¼

TELEGRAPH AND TELEPHONE.

American Bell Telephone	100	202	203
American District Telegraph	100	30	40
American Telegraph & Cable	100	92½	..
Central & South American Telegraph	100	117	120
Commercial Cables	100	150	..
†Erie Telephone	100	57	57½
Gold & Stock Telegraph	100	105	..
New England Telephone	100	70	71
New York & New Jersey Telephone	100	103	105
Postal Telegraph-Cable	100	63½	..
Western Union Telegraph	100	92¾	92⅞

ELECTRIC TRACTION STOCKS.

Baltimore Traction	25	18¼	18⅜
Binghamton RR. com	100	100	..
Brooklyn Traction	100	9	12
" " pref.	100	..	53
Buffalo St. Ry	100	72	..
Cleveland City Ry.	100	68	70
Cleveland Electric Ry.	100	59	60
Chicago City Ry	100	305	315
Columbus St. Ry	100	48½	..
Consolidated Traction of N. J	..	26	30
Electric Traction, Philadelphia	50	73	73½
Long Island Traction	100	8¼	9
Louisville St. Ry. com.	100	37	39
" " " pref.	100	87	88
Metropolitan Traction, Philadelphia	100	94½	94¾
New Orleans Traction	100	14½	16
" pref.	100	56	60
North Shore Traction	100	23	28
" " pref.	100	80	84
People's Traction $30 pd.	25	60⅛	60¾
‡Philadelphia Traction	50	82½	82¾
Rochester St. Ry	..	38	..
Union Ry. (Huckleberry)	100	112	115
West End, Boston	100	68½	69
" " pref	100	90	..
Worcester Traction	100	13	16
" " pref	100	83	87

BONDS

Buffalo St. Ry. 1st con. 5s	100	104	105
*Binghamton Railroad Co. 5s	100	99	100
*Columbus St. Ry. 1st 5s	100	98	..
Rochester St. Ry. 1st. 5s	100	95	97
*Union Ry. 1st. mtge 6s	100	105	108
*Westchester Electric 1st. mtge. 5s	100	98	101

* With accrued interest.

† Ex-Div.

‡ Ex-rights.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
253 BROADWAY, NEW YORK, May 27, 1895.

MR. NORMAN MARSHALL, vice-president of the Anchor Electric Company, of Boston, paid this office a pleasant visit last week.

A BIG DEAL.—The Citizens' Electric Light Company, of Brooklyn, last week passed into the control of the Edison Electric Illuminating Company after three weeks of negotiations. Both companies will retain their separate corporate existence, and the Citizens' station will be operated from the Pearl Street station of the Edison Company.

THE MONTAUK, ORIENT AND N. Y. TELEPHONE & TELEGRAPH COMPANY, a local corporation in Mattituck, L. I., is in trouble because the N. Y. & N. J. Telephone Company is extending its lines all over Long Island. The stock of the local company was selling at a premium until the operations of the larger telephone company became known. The capital stock of the small company was $5,000. The Brooklyn company offered to consolidate and take 60 per cent. of the stock if the Mattituck company would raise its capital to $50,000. The smaller company has refused the coalition, and consequently the larger one is branching out and covering the ground which the smaller company would have covered.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
ROOM 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, May 25, 1895.

THE WADDELL ENTZ plant at Bridgeport was sold last week to Percival Knauth, of New York, for $60,000.

CHEAP RIDING.—The N. Y., N. H & H. R. Ry. Company has decided upon a schedule of fares for its Nantasket Beach electric system, which will enable a passenger to ride from the Old Colony House to the Pemberton landing in Hull for five cents. The work of changing over this branch from steam to electricity is expected to be finished by June 1.

AN IMPORTANT DECISION has been rendered by Corporation Counsel Bailey to the effect that the city has the power to compel the West End (or any other) railway company to run cars when and where it may be deemed necessary for the convenience of the citizens, provided reasonable grounds can be shown for the running of such cars. The expense of operation and extent of probable patronage enter into the determination of "reasonable grounds."

CANADIAN NOTES.

TORONTO, Ont., May 23, 1895.

NIAGARA FALLS, ONT.—It has been decided to change over the Clifton & Drummondville street railway to electricity.

NESS, McLAREN & BATE, 749 Craig Street, Montreal, have succeeded to the manufacturing and supply business of the old firm of T. W. Ness & Co., and have purchased the entire stock of James L. Rankin, which they intend to dispose of at cut prices.

MONTREAL, QUE.—The Montreal General Hospital will receive tenders, first, for the plant necessary for supplying electric current in the hospital, say for 1,000 lights of 16 cp; second, for supplying the same number of lights, and in addition four motors of an average of 9 hp each.

ENGLISH NOTES.

(From Our Own Correspondent.)

LONDON, May 15, 1895.

ELECTRICALLY PROPELLED VEHICLES.—It was announced in the House of Commons last week that a bill regulating the propelling of vehicles by electricity on common roads would shortly be introduced.

MUNICIPAL PURCHASE OF ELECTRIC LIGHT UNDERTAKINGS.—The Liverpool Electric Supply Company is apparently about to be bought up upon very favorable terms, by the corporation of Liverpool. The present paid-up capital of this company is £250,000, and I understand that there is every likelihood of their getting £400,000 from the corporation for their business.

MUIRHEAD AND OTHERS VS. COMMERCIAL CABLE COMPANY.—The action brought by Dr. Alexander Muirhead and others to enforce the payment of royalties by the Commercial Cable Company for the use of their "Duplex" patent, which was decided in favor of the plaintiffs in the court of first instance, and against the plaintiffs on appeal, came before the House of Lords yesterday and was amicably settled, the company having agreed to pay the plaintiffs a large sum by way of damages.

ELECTRIC RAILWAY WORK.—A curious case of considerable interest to the electrical industry, recently came before the law courts. It was an appli-

cation by the receiver of the Mersey Railway Company for permission to spend £800 in promoting a bill in Parliament, granting the company power to run its trains by electricity. The Court decided that money could not be legally expended in this way, at any rate unless there was unanimity on the point, which in this case there was not. Those, therefore, who desire to see this line worked electrically will have to pay the necessary parliamentary expenses out of their own pockets.

ELECTRIC TRACTION AT LEEDS.—It is now a little more than a year since the Leeds municipality took over the entire tramway system of that city. The aggregate mileage at present is 27 miles of track, and a proposal is now before the Town Council to provide the entire system and its extensions, amounting to some 14 miles, with electric traction, and this, with the exception of a few miles in the centre of the city, on the overhead trolley system. I may say that the receipts for the first year's working of the tramways by the municipality amounted to £51,000 and the expenditure to £44,000, the gross balance of nearly £7,000, owing to the necessity for provision for interest and capital redemption, being reduced to a net balance of £133. It may be urged in defence of this small return that the municipality, owing to the bad state in which the track and equipment were left by the company, has been under the necessity of effecting unusually heavy repairs out of revenue, and has of course, simultaneously reduced its employees' hours of work, and raised their aggregate wages.

ELECTRIC COMMUNICATION WITH LIGHT-HOUSES AND LIGHT-VESSELS.—The third report of the Royal Commission appointed to inquire into the subject of electrical communication with light-houses and light-vessels has just been issued, the first report having been published in December, 1892, and the second in March, 1894. The report gives some interesting particulars with regard to the liability of the cables to interruption, and with regard to the use made of the cables recently laid down. The commission state that they are satisfied that the recent telephonic connections have added in a very important degree to the effectiveness of the machinery which exists on the English coasts for the purpose of rendering aid to vessels in distress and to saving their crews from the perils of the sea; such connections not only enable light-house keepers and the crews of light-vessels to warn life-boats, as did the old visual signals, but they enable precise particulars to be sent to the shore as to the position and size of the vessel in distress. The report closes with an announcement that the members of the Royal Commission propose to proceed this summer to Denmark, and with a recommendation for further connections to cost £8 500 the new points to be connected including one light-vessel, one pile light-house, one rock light-house, and three shore light-houses.

THE WILLANS ENGINE.—An important paper "On the Recent Development of the Single-Acting High-Speed Engine for Central Station Work," was read by Mr. Mark Robinson at the Institution of Electrical Engineers on May 9. The paper, which embodies a description of the construction and action of the Willans engine deals principally with the merits of high-speed single-acting working for electric supply stations. The advantages of this type were considered in relation to economy, durability, cheapness of first cost, absence of vibration and several other points. A discussion was opened by Mr. Raworth of the Brush Company, who, in a very judicious speech, advocated the use of high-speed, but deprecated single action. Mr. Raworth paid several tributes, however, to the Willans engine. He was of the firm opinion that the high economy of this engine arises not so much from single action, as from the relative shortness of the stroke and the consequent effect of the clearance spaces. In his opinion, a bearing can be better lubricated if it is not under a constant thrust than if, as in the Willans engine, it is so maintained; for in Mr. Raworth's opinion, the alternation of thrust would enable oil to better distribute itself over the whole bearing surface. We expect to have an interesting continuation of the discussion at the next meeting, when the institution adjourns for the summer vacation.

MUNICIPAL ELECTRIC LIGHTING LOANS.—There has been a battle royal proceeding for some time past between the vestries of London on the one hand, and the London County Council and the government on the other; the former wishing to extend, as far as possible, the period over which they may spread the repayment of their electric lighting loans, and the latter wishing to curtail the same period within reasonable limits. The first proposal of the County Council was to strictly apportion the period of re-payment to the probable life of the particular item upon which each sum was to be expended. This idea was, no doubt, academically correct, but was practically impossible to carry into effect, and was withal, a somewhat irritating suggestion. Next, the government and the County Council decided that the money should be lent for 50 years in the case of loans granted for lands, buildings, culverts, bare copper mains, etc., and for 20 years only in the case of money expended on engines, boilers, dynamos, etc. The vestries of London have stood out for a period of 42 years irrespective of the object upon which the money was to be expended. This period they have at last succeeded in securing, the only proviso being that when money is granted to them for electric lighting purposes for this period, all renewals and repairs are to be paid out of the revenue. It is to be hoped that this decision is final as the requirements of sound finance seem to be met by this plan.

General News.

NEW INCORPORATIONS.

THE PEOPLE'S TELEPHONE COMPANY, Haverhill, Mass., capital stock $1,000, has been formed to transmit intelligence and to deal in telephone instruments. Ed. H. Hoyt, P. C. Sweet and Franklin Woodman are interested.

THE GUAYAQUIL GENERAL ELECTRIC COMPANY, of New York, has been incorporated to do electric lighting and all other business in which electricity is used. Maximum capital $50,000. Promoters, Manuel de J. Alvarado, Brooklyn, N. Y.; Vicente Harvie Emes, Frank E. Rogers, N. Y. City.

NEWTOWN LIGHT & POWER COMPANY, Newtown, L. I., N. Y., has been incorporated with a capital stock of $20,000, to generate and sell electricity. The promotors are I. C. Smith, Babylon, L. I., N. Y.; C. B. Gallagher, Brooklyn, N. Y.; Francis McKenna and Geo. S. Jervis, Maspeth, L. I., N. Y.

THE CITIZENS' RAILWAY COMPANY, Denver, Col., capital stock $500,000, has been formed to build and operate electric railway lines to connect Denver with other towns in Jefferson and Boulder counties. Milo A. Smith, Chas. E. Hawyer, E. S. Smith, Clarence M. Cobb and Thos. W. Porter, all of Denver, are interested.

THE LA SALLE CONSTRUCTION COMPANY, Chicago, Ill., capital stock $100 000, has been formed to construct railways or tramways to be operated by steam, electricity, or other motive power; build bridges, boats, barges, and do a general contracting business. The promoters are W. E. McClurg, C. H. Bumstead and F. S. Donnell.

THE CITY & PROSPECT HEIGHTS STREET RAILWAY COMPANY, Peoria, Ill., capital stock $150,000, has been formed to construct, maintain and operate a street railway to be operated by horse, electric or other motive power. The promoters are W. S. Turner and Chas. Edwards, Woodbridge, Ind., and Jno. C. White.

ALAMO HEIGHTS RAILWAY COMPANY, San Antonio, Tex., has been incorporated to operate street railways and suburban or belt lines of railways within or near San Antonio, Tex., by Chas. W. Ogden, C. L. Harwood, S. K. Buchanan, San Antonio, Tex.; Edwin Packard, Spencer A. Jennings, Brooklyn, N. Y. The capital stock is $62,000.

THE BELL ELECTRIC COMPANY, Trenton, N. J., has been incorporated with a capital stock of $100,000, to manufacture and sell electric singe cutting combs and other electric apparatus and appliances. Frank M. Bell, New York; Geo. A. Westbrook, Wm. Childs, Jr., Brooklyn, and Abram V. Robinson, Trenton, N. J., are the promoters.

THE LA CROSSE, BLACK RIVER FALLS & MILLSVILLE ELECTRIC RAILWAY COMPANY, La Crosse, Wis., has been incorporated. The capital stock is $500,000. The company proposes to build an electric road from La Crosse to Millsville. The promoters are N. Clark, P. McHugh, Wm. H. Polleys, T. J. McHugh, Wm. Burns, La Crosse, Wis.

THE HARRINGTON, FREDERICA & DENTON ELECTRIC RAILWAY COMPANY, Denton, Md., has been incorporated with a capital stock of $350,000, by Robert W. Reynolds, Ezekiel Fleming, H. Harrington, B L. Lewis and others, to build and operate an electric road extending from Frederica to Burrsville and passing through the town of Harrington, thence to Denton.

THE BISSELL, DODGE & ERNER COMPANY, Toledo, O., capital stock $25,000, has been formed to manufacture, repair and deal in all kinds of electrical and other machinery, tools, etc.; also to contract for and construct all kinds of electrical and mechanical plants, etc. The promoters are Fred Bissell, Fred H. Dodge, John A. Erner, A. W. Scott and G. G. Keip.

THE MILWAUKEE & WAUKESHA STREET RAILWAY COMPANY, Milwaukee, Wis., has been incorporated with a capital stock of $1,000,000. Among those interested in the company are Max Rosenthal, James Pettro, A. B. Meyers, Stutley I. Henderson, Jacob Wellauer and Joel W. Bingham, of Milwaukee, and John J. Constantine, Charles Pettelkow and Andrew Snyder, of Waukesha.

THE SANBURN ELECTRIC RAILWAY COMPANY, Chicago, Ill., has been incorporated with a capital stock of $250,000. The incorporators are James W. Kenney, Oscar L. McMurray, Homer K. Galpin, J. S. McGlashin, of Chicago, and George O. Talbot, of DeKalb, Ill. It is the purpose of the company to construct an electric railway from Chicago to towns in Cook, Lake and DuPage counties.

THE DIGHTON, SOMERSET & SWANSEA ELECTRIC STREET RAILWAY COMPANY, Taunton, Mass., has been organized with the following officers: President, Col. B. D. Davol, Fall River; clerk, Orville A. Barker, Taunton; treasurer, S. M. Thomas, Taunton. The directors are the officers and F. M. Brightman, of Fall River; Cornelius A. Davis and Henry B. Leonard, of Somerset; N. Allen Walker, of Dighton; J. N. Beckley and George Wellman, of Rochester; N. Y., and Henry H. Crapo, of New Bedford.

TELEGRAPH AND TELEPHONE.

NEW BERNE, N. C.—The city has granted a franchise to P. H. Pelletier, James Redmond, and others to establish a telephone system.

NIAGARA FALLS, N. Y.—The Postal Telegraph Company has commenced excavating for the conduits in which to lay its wires on Fall Street.

WATERTOWN, N. Y.—The Central New York Telephone & Telegraph Company has announced a reduction of telephone rates to $24 a year for business places and $18 a year for private residences.

REYNOLDSVILLE, PA.—A $25,000 school building will be erected here, and it is proposed to put in an interior telephone system to connect the principal's room with the class-rooms. M. M. Davis is secretary of the school board.

UTICA, N. Y.—At a recent meeting of the Baxter Overland Telephone & Telegraph Company, a committee was appointed to confer with an electrical expert and secure estimates as to the probable cost of placing the plant of the company in operating order. Directors: C. W. Mather, J. N. Turnbull, Benjamin B. Gilbert.

GALVESTON, TEX.—The Southwestern Telephone & Telegraph Company will connect Marlin with all the principal points in the State. A complete system will be introduced in the city. The company will construct a four-wire line from Bremond to Waco, thus connecting Marlin with the line in course of construction from Houston to Corsicana.

ELECTRIC LIGHT AND POWER.

NORWOOD, O.,—The citizens have voted to issue bonds for an electric lighting plant.

EASTPORT, ME.—H. Blanchard & Sons are in the market for a 100-light incandescent plant.

ALBION, N. Y.—A movement is in progress to extend the Morton-Troutburg telephone line to Holley.

SLEEPY EYE, MINN.—The village electric light plant was recently destroyed by fire. Loss $8,500.

BALTIMORE, MD.—The Park Board has decided to substitute arc lights for the incandescents now in use at Druid Hill Park.

MURFREESBORO, TENN.—A bill has been passed in the legislature authorizing the city to issue bonds for an electric light plant.

SPRINGFIELD, MO.—An election will be held soon to vote on the issue of $60,000 in bonds to establish a municipal electric light plant.

ST. IGNACE, MICH.—J. F. Keightley has been granted a 30-year franchise for an electric light plant and telephone system at Mackinac Island.

NORTHFIELD, VT.—At a village meeting, recently held, it was voted to purchase an engine for the electric light plant. F. L. Howe is clerk.

WILLIAMSTOWN, PA.—The Williamstown Borough Council has granted right of way to the Lykens Valley Telegraph & Telephone Company.

LANSINGBURGH, N. Y.—Sealed proposals will be received until 8 p.m., June 10, for lighting the streets by electricity. George Gramm is village clerk.

LA CROSSE, WIS.—Engineer Cole has been instructed to make plans for and estimate the cost of an electrical light plant for street and other public lighting.

MARTINS FERRY, O.—At a meeting of the City Council, the light committee was instructed to take options for 30 days for a site for the electric light plant.

MADISONVILLE, CONN.—I. Bailey wants estimates on a complete electric light plant to furnish 50 arc lights of 2,000 cp each, and 500 incandescent lights of 16 cp each.

FLUSHING, L. I., N.Y.—The Business Men's Association has passed a resolution requesting the village trustees to have Broadway and Main Street lighted by electricity.

LEXINGTON, KY.—Sealed bids will be received until June 19 for lighting the streets on an all night schedule with gas or electricity or both for five or ten years from Oct. 1.

HAMILTON, ONT.—The Hamilton & Lake Erie Power Company have made application for a charter to the Parliament to acquire a site for and to build electrical works, etc.

PORTLAND, ME.—The Dirago Telephone Company, of Maine, has made application to the city for permission to erect lines of telephone poles and to lay telephone wires underground.

EAST BRIDGEWATER, MASS.—The Whitman Electric Light Company has accepted the franchise offered it by the East Bridgewater Selectmen, and will at once commence to wire the streets of that town.

CAMDEN, N. J.—At a meeting of the Board of Freeholders, an appropriation of $2,000 for an electric plant at the asylum almshouse was made. Freeholders Young, Martin and Anderson are in charge.

WASHINGTON, D. C.—Sealed proposals will be received at the office of the District Commissioners until 12 m., June 3, for lighting the streets of the District of Columbia, other than for present arc lamp service, beginning July 1.

BROOKLYN, N. Y.—The Department of City Works, Municipal Building. Sealed proposals will be received until 12 m., June 4, for furnishing electric lights for the streets and public buildings of the city of Brooklyn for the year 1895. Alfred T. White is commissioner.

PHILADELPHIA, PA.—The Overbrook Electric Light Company asks the Common Council for leave to erect its lines on the streets running through the property of the Drexel syndicate, and for the location of 33 public lights, for which it will maintain five free of cost to the city.

ATHENS, O.—Sealed proposals will be received until June 20, at the office of the superintendent of the Athens State Hospital for a complete electric lighting plant for that institution. Plans, etc., are on file at the hospital, or can be had on application to Dr. C. O. Dunlap, superintendent.

EL PASO, TEX.—Sealed proposals will be received at the office of the city clerk until Aug. 2, for lighting the streets of the city by electricity, for a term of five years, from Dec. 1. Not less than 50 lights to be furnished, and as many more as the City Council may order. All lights to be of not less than 1,200 candle-power, and to be run by moon schedule.

CLARE, MICH.—Mr. A. J. Doherty, president and general manager of the Clare Electric Light Company, has just completed a new central station plant consisting of a 1,000-light Wood incandescent dynamo, a 50 light Wood arc dynamo and a 150-hp Russell four-valve engine. Cost of plant, $10,000; building and pole line, $5,000. The company has a five-year contract for the city lighting. Mr. Doherty expresses himself as more than pleased with the new machinery.

THE ELECTRIC RAILWAY.

PITTSFORD, VT.—An electric road from Pittsford to Rutland by way of Proctor, is talked of.

MANCHESTER N. H.—The Manchester Street Railway Company will extend its road to Lake Massabesic.

OSHKOSH, WIS.—The Oshkosh Street Railway Company is taking preliminary steps toward electric equipment.

DUBLIN, PA.—At a cost of $128,000, the trolley line will be built from Dublin to Souderton, a distance of eight miles.

NEWARK, N. J.—Ground has just been broken for the construction of the Passaic & Newark Electric Railway at Franklin.

EVANSBURG, PA.—P. A. Shoemaker, of Evansburg, is interested in the promotion of an electric railway from Johnstown to Evansburg.

ALLENTOWN, PA.—Lahr, Leh & Martz, surveyors for the Allentown & Reading Trolley Railway, have received orders to complete the survey

LAPORTE, IND.—The Common Council has granted a 25 year franchise for a street railway to H. B. Tuthill and A. G. Tillotson, of Michigan City.

ATLANTIC CITY, N. J.—It is proposed to construct a trolley line from Atlantic City to Camden. James Scott, of Chester, Pa., can probably give information.

UTICA, N. Y.—Clinton Beckwith, of Herkimer, N. Y., is the chief promoter of the company organized to build and operate a road between Franklin and Utica.

ORLANDO, FLA.—E. W. Henck has commenced surveying with a corps of engineers for his electric railway to parallel the South Florida Railway to Orlando.

MILWAUKEE, WIS.—The McGartney Street Railway Company of the west side has commenced running cars. This line will be extended several miles this summer.

PITTSFIELD, MASS.—The Pittsfield Street Railway Company has petitioned the city authorities for permission to extend its tracks through Orchard and other streets.

YOUNGSTOWN, O.—A special election was held at Canfield, this county, for bonding the township to build an electric street railway to this city, a distance of ten miles.

NEW BRUNSWICK, N. J.—The New Brunswick Street Railway Company has consummated the purchase of property for a power house for the trolley road to be built soon.

WILKESBARRE, PA.—At a meeting of the City Council an amendment to the ordinance was submitted, permitting the Traction Company to construct a railway over the heights.

TOLEDO, O.—The five street car lines, commonly called the Consolidated Street Railway system, have been incorporated under one head, known as the Toledo Traction Company.

WATERLOO, N. Y.—The Corporation Board of Waterloo has granted a franchise to the Geneva, Waterloo, Seneca Falls & Cayuga Lake Railway Company to extend its line to Waterloo.

PERTH AMBOY, N. J.—Edward Radell, secretary of the new trolley company that is to encircle Middlesex County, is at work upon plans for the road. Gottfried Cruger is also interested.

FLUSHING, L. I., N. Y.—The Board of Supervisors has granted permission to the Atlantic Improvement Company to extend trolley lines to the Long Island City and Newtown road to Flushing.

EAST BRIDGEWATER, MASS.—The Selectmen of East Bridgewater will grant a franchise to the Brockton and East Bridgewater companies for the construction of an electric railway through the town.

HARTFORD, CONN.—At a recent meeting of the Board of Aldermen, a petition was received from the Hartford Street Railway Company asking for privileges to build a double track on Farmington Avenue.

TROY, N. Y.—Electricity will be used as the motive power on the new road, although the roadbed will be so constructed that steam may be used when the Troy & New England scheme is entirely carried out.

KANSAS CITY, KAN.—The car house and machine shop of the West Side Street Railway Company, Third and Oakland Avenues, recently damaged by fire to the extent of $25,000, will be rebuilt on the same site.

HARTFORD, CONN.—A meeting will be held by the Common Council at the City Hall, to consider the plans of the Hartford Street Railway Company for additional tracks on various streets of the city. Henry F. Smith is city clerk.

STONEHAM, MASS.—It is proposed to build an electric street railway between Stoneham Winchester and Arlington. Hon. Onslow Gilmor, of Stoneham, and Hon. A. B. Coffin, of Winchester, will be on the board of directors.

CLINTON, N. Y.—It is proposed to build an electric railway from Clinton to New Hartford, connecting with the Utica Belt Line Road. A committee consisting of Ellery Stebbins, Francis Tasker, James L. Dempsey and others have viewed the proposed route.

CAPE ELIZABETH, ME.—The Cape Elizabeth Street Railway Company has been organized for the purpose of constructing and operating by electricity or animal power, a street railway. Directors: Jacob S. Winslow, of Portland, Me.; Albert D. Boyd, of South Portland, Me.

NEWBURGH, N. Y.—Surveyors have been making preliminary surveys of the towns of Newburgh, Marlboro and Lloyd, for the purpose of establishing a trolley route to connect the Walden extension of the Newburgh & Walden Electric Railway with the Poughkeepsie bridge.

FAIR HAVEN, CONN.—The Fairhaven & Westville road has purchased the charter of the New Haven & North Haven Electric Street Railway Company, with the right to run out Davenport Avenue to Mt Montowese, about two miles, and the construction will be commenced at once.

THE FORT MADISON WATER COMPANY has been incorporated at Portland, Me., with a capital stock of $250,000, to manufacture gas and electricity, machinery and fixtures for gas, electric and water plants. The promoters are Wm. C. Eaton, Edw. D. Noyes, and Geo. F. Noyes, Portland, Me.

RUMFORD FALLS, ME.—At a meeting of the Rumford Falls & Rangeley Lake Railway directors, held in Portland, May 11, it was voted to extend the road to Rangeley Lake this summer. The directors are desirous of receiving bids for the same, which will be opened June 10. Waldo Pettingell is resident engineer.

MILFORD, MASS.—Boston capitalists have notified Milford business men that they would help to operate a trolley road from Milford Postoffice to Hopkinton Centre, if a reasonable Milford franchise was given. C. W. Shippee, a local manufacturer, treasurer; R. B. Green, of the Milford Electric Light Company, and others are interested.

BROOKLYN, N. Y.—The Union Street Railway Company has renewed its petition of June and July, 1892, and its petition of May 22, 1893, for permission to construct, maintain and operate a street surface railway, to be operated by electric motive power, with the necessary switches, etc., from Ferry Place through Hamilton Avenue to Union Street, and thence through Union Street to Ninth Avenue.

Trade and Industrial Notes.

HARRY M. SHAW, dealer in electrical supplies, at 136 Liberty Street, New York reports a great improvement in business. Mr. Shaw has been appointed New York agent for the Eureka Tempered Copper Company.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, has issued a handsome 72-page catalogue containing full data concerning its well-known "Chloride" accumulators, as well as charging switches, special switches, measuring instruments and all accessories to accumulator work.

THE ELECTRIC APPLIANCE COMPANY, of Chicago, reports having just closed arrangements for the exclusive sale in the West of the well-known Upton arc lamps for direct and alternating constant-potential circuits and regular series arc work. The lamp is extremely simple in construction and correspondingly low in price and is meeting with favor.

A. L. BOGART, 22 Union Square, New York, has succeeded in perfecting a system of electric gas-lighting applicable to Welsbach burners which has been adopted by the parent manufacturing company. The system includes devices for lighting by plain pendant pulls, pillar cock pendants, push buttons, etc., corresponding with the standard gas lighting systems well known to the trade.

THE HUYETT & SMITH MANUFACTURING COMPANY, of Detroit, Mich., has issued a new catalogue—No. 29—of ventilating fans, cupola and forge blowers, exhaust fans, etc. There are furnished with pulleys or direct-connected to electric motors, steam engines, or water motors, as may be preferred by the purchaser. The catalogue is well illustrated and rather handsomely executed.

THE METROPOLITAN ELECTRIC COMPANY, 186-188 Fifth Avenue, Chicago reports a very good demand for the well-known P. & B. products, and the portable hose bridge recently illustrated in THE ELECTRICAL WORLD, for which several orders have been received. The company is now in position to fill orders from stock for the well and favorably known solar arc lamp for incandescent circuits.

THE M. C. BULLOCK MANUFACTURING COMPANY, 1170 Lake Street, Chicago, is distributing a fine new catalogue of its Willans "central valve" engines, in which the engines are fully described and illustrated. Some interesting curves are given, which were obtained from a test of a combined Willans engine and Siemens dynamo. The construction and action of the engine are exhaustively explained.

THE HOPPES MANUFACTURING COMPANY, of Springfield, Ohio, has just closed a contract with Russell B. Harrison, president of the Terre Haute Electric Railway Company, Terre Haute, Indiana, for two live steam feed-water purifers of 1,000 hp capacity. It also reports the following recent sales of its exhaust steam heater to electric lighting and railway stations: Columbus Central Railway Company, Columbus, O., 1,100 hp: Rochester Railway Company, Rochester, N. Y., 2,250 hp.; Sheridan Electric Company, Sheridan, Wyo., 200 hp; Kansas Light & Water Company, Lawrence, Kan., 200 hp.

THE PHŒNIX IRON WORKS, of Meadville, Pa., reports the following sales of "Dick & Church" engines, by Edward F. Austin, manager of the Pittsburgh office of the company: One 16x15 automatic cut-off engine to the National Water Works & Construction Company: two 300-hp engines to the Detroit & Mt. Clemens Electric Railway; three 14½x15 automatic cut-off engines to the National Tube Works Company, of McKeesport, Pa., and one 18½ x 18 automatic engine, together with two boilers, feed-water heater, pump, etc., to Robert Simons, president of the Pittsburgh, Frontenac & Suburban Railway Company, of Pittsburgh, Kan. Mr. Austin reports the boiler department running to full capacity and the outlook for business good.

THE WALKER MANUFACTURING COMPANY, Cleveland O., reports the following recent sales: Detroit Railway Company, Detroit, Mich., one 750-kw direct-connected generator, being the second machine of this size which the Detroit Railway have ordered from the Walker Company; Aurora Street Railway Company, Aurora, Ill., nine complete car equipments, and 18 25-hp steel motors (this order was awarded after a thorough test had been made of three or four of the leading makes of motors, and is the second order awarded the Walker Company by the Aurora Company); Akron Street Railway Company, Akron, O., two 200 kw direct coupled generators; three complete car equipments, six 30-hp steel motors (this is the third order received from the Akron Street Railway Company); New York, Elmsford & White Plains Railway Company, White Plains, N. Y., one 75-kw belted generator; three complete car equipments, six 25-hp steel motors; Lakeside Railway Company, Mahanoy City, Pa., two complete car equipments, four 50-hp steel motors; W. C. Thayer, Cleveland, O., two 200-kw direct coupled generators, 10 complete car equipments, 20 50-hp steel motors, one complete car equipment, two 100-hp steel motors; Ashland & Catlettsburg Street Railway Company, Ashland, Ky., two complete car equipments, two 30-hp steel motors. The shops of the Walker Company are still running both day and night, and their force is being increased almost every day.

THE BALL ENGINE COMPANY, of Erie, Pa., reports the following recent shipments: Library of Congress, Washington, D. C., three 175-hp engines, direct-connected to Mather dynamos; Rock Creek Railway Company, Washington, D. C., one 300-hp tandem-compound engine with extended sub-base and divided connecting head; Hahne & Co., Newark, N. J., one 125-hp engine; Baltimore City Jail, Baltimore, Md , one 85-hp engine; C. Jevne & Co , store building, Chicago, one 60-hp engine, direct-connected to Siemens and Halske dynamo; City of Wells, Minn., one 70-hp engine, direct-connected to General Electric dynamo; Catholic University, Washington, D. C., two 50-hp engines; Tootle, Wheeler & Motter, store building, St. Joseph, Mo., one 100-hp engine; Mount Washington Light & Power Company, Hollins, Md., one 100-hp engine; J. M. Warner, electric light plant, Oneida, N. Y.; one 60-hp engine; Tarentum Passenger Railway Company, Tarentum, Pa., one 100-hp engine; Swofford Dry Goods Company, Kansas City, Mo., one 60-hp engine; Juvenile Female Offenders' Home, Geneva, Ill., one 60-hp engine, direct-connected to C. & C dynamo; C. E. Johnson & Co., Chicago, one 40-hp engine, direct-connected to Western Electric dynamo; J. F. Weissner & Sons, brewery, Baltimore, Md., one 50-hp engine; Duquesne Electric Supply & Construction Company, Pittsburgh, Pa., one 85-hp engine; C. D. Kaier Brewing Company, Mahanoy City, Pa., one 60-hp engine: Chesapeake Light & Power Company, Hampton, Va., one 40-hp engine; Bucyrus Steam Shovel Company, Bucyrus, O., one 25-hp engine; City Bank Building, Buffalo, N. Y., one 60-hp engine; D. M. Rhea, Fulton, Ky. one 125-hp engine; Western Electric Company, Chicago, one 60-hp engine direct-connected to Western electric dynamo.

Business Notices.

ELECTRIC LEAGUE.—Meets every Thursday evening, 100 West 24th Street. Electrical engineers and electricians cordially invited.

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren Street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED MAY 21, 1895.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

539,418. CONDUIT SYSTEM FOR ELECTRIC RAILWAYS; W. H. Cotton, St. Louis, Mo. App. filed Aug. 25, 1894. The combination of a conduit having therein a contact shoe consisting of a flexible central insulated web or partition having metallic sides, the said sides being provided with upright contact rollers and divided into sections having interlocking ears or lugs.

539,431. ELECTRIC BELL; F. G. Ingersoll, New York, N. Y. App filed Oct. 26, 1894. The combination of an electromagnet, an armature carrying a contact, a stationary conducting strip, an insulating block, a plate of insulating material partly covering the said strip and provided with inclined sides, and a stop to limit the movement of the armature.

539,437. MICROPHONE; E. J. P. Mercadier and J. M. Anizan, Paris, France. App. filed June 3, 1893. A microphone having a vibrating plate, rotatable carbon pencils and flexible spring wires arranged for mechanically changing the microphonic contact points of the said carbon pencils.

539,446. SYSTEM OF ELECTRICAL DISTRIBUTION; E. W. Rice, Jr., Swampscott, Mass. App. filed May 24, 1893. A system comprising separate circuits connected together in multiple; switches at intervals along said circuits whereby the main circuit is divided into sections, normally open cross-connections connecting the circuits of one section with the opposite circuits in the next section, and a two-way switch whereby either of said cross-connections may be close-circuited, and ground terminals at the ends of said sections adapted to be connected to either of the circuits.

539,450. SYSTEM OF ELECTRICAL DISTRIBUTION; C. P. Steinmetz, Schenectady, N. Y. App. filed Dec. 20, 1894. A method of electrical distribution consisting in supplying alternating currents of a given phase relation for operating light coupled in one of the branches into which the system is divided, and alternating currents of different phase relation for operating motors connected to one or more other branches of the system, and transferring energy between the lighting and motor branches through a balance wire to preserve the proper distribution of load.

539,452. ELECTRIC METER: C. P. Steinmetz, Schenectady, N. Y. App. filed Feb. 19, 1895. A meter comprising recording and braking mechanism, and two armatures on the same shaft or geared together, one in circuit across the main power leads with an appropriate resistance, and the other in circuit between the teaser wire and a neutral point dividing the voltage in the main circuit; field coils for the two armatures, and means for maintaining the excitation of the field coils proportional to the current flowing in the main and teaser circuits.

539,453 and 539,454. CARBON BRUSH. E. Thomson, Swampscott, Mass. Apps. filed Feb. 6, 1895. A brush composed of carbonized fibrous material of woven texture, the layers of which are plated with metal and assembled together to the required thickness, and are united at one end and enclosed with a strengthening case.

539,484. ELECTRO-THERAPEUTICAL BODY WEAR; W. J. Newton, H. L. Purbrook and H. De C. Hudson, Wellington, New Zealand. App. filed Aug. 31, 1894. The combination of a belt, a battery, the electrodes being connected therewith and arranged to different points on the belt, a breastplate having a contact surface to bear on the body.

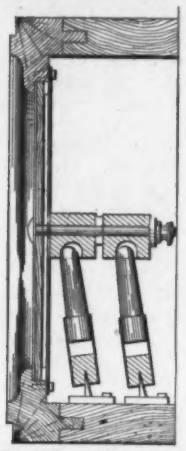
539,500. AUTOMATIC TIME SWITCH FOR STORAGE BATTERIES; W. Biddle, Brooklyn, N. Y. App. filed May 18, 1894. The combination of two secondary batteries and an energizing dynamo, a time controlled circuit-closer formed of a disc with insulating material and metallic contacts, springs resting upon suc circuit closer, a three-point switch and two electromagnets and their armatures acting in opposite directions, conductors extending from the secondary batteries to the two insulated contacts on the moving switch, and circuit connections to the stationary contacts of this switch.

539,501. ELECTRICAL INSTRUMENT FOR MEDICAL PURPOSES; B. Y. Boyd, Wichita, Kan. App. filed Aug. 27, 1894 An instrument consisting of an outer handle having the positive and negative parts, an insulator forming the lining and separating the positive from the negative, and a galvanic battery having positive and negative poles connecting the said outer casing with the battery.

539,511. SIGNAL BOX ATTACHMENT; A. Gruner, San Francisco, Cal. App filed July 28, 1894. A call box having mechanism set by outside means, an electromagnet with a local circuit, a spring-actuating lever in the box, with

an extension on the lever for retaining the mechanism in a set condition, and an interlocking connection between the armature and lever, released upon the downward movement of the armature.

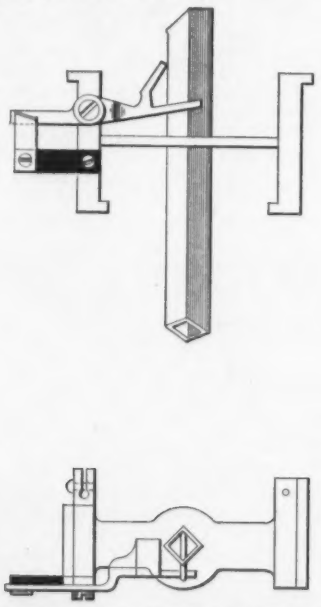
539,512. TELEGRAPH RELAY; A. Gruner, San Francisco, Cal. App. filed July 28, 1894. The combination of a magnet having independently operated coils, a battery, independent wires leading from the coils to the battery, and from the battery to a main circuit, a supplemental wire leading from the battery and forming an auxiliary intermediate circuit through the ground or otherwise, and a switch in the ground circuit.



No. 539,437.—Microphone.

539,516 TROLLEY FOR ELECTRIC RAILWAYS; J. W. Hoag, Newark, N. J. App. filed Jan. 19, 1895. The combination of a trolley arm, a bracket connected therewith, a tubular post having projecting arms mounted upon it, and means for connecting the arms.

539,529. ELECTRIC RAILWAY SIGNAL; H. V. & A. C. Miller, Bloomington, Ill. App filed Jan. 5, 1895. A signal system having a ground connection adapted to be used in connection with an electrically actuated signal, having an auxiliary contact rail, an electromagnet interposed between it and the ground, a make and break armature lever for the magnet provided with an insulated contact piece, two contact posts, one of which is adapted to be electrically connected with the ground when contacted by the make and break armature lever, so constructed that when current flows from the rail through the magnet to the ground the armature lever with its contact piece is vibrated to close the ground connection.



No. 536,622.—Cut-Out for Arc Lamps.

589,559. ELECTRICAL LOW WATER INDICATOR FOR BOILERS; C. D. Tisdale, Boston, Mass. App. filed April 19, 1894. The combination of a glass tube connected with the boiler above and below the normal water level of the boiler, an auxiliary connecter inserted between the lower boiler connection and the lower end of the glass tube, electrical conductors extending through the sides of the auxiliary connector, thence upwardly in the glass gauge tube, a metal float having a convex surface and adapted to form an electrical connection between the electrical conductors, and an electrical generator and alarm device.

539,576. ELECTRIC SAFETY SYSTEM FOR RAILWAY DRAWBRIDGES; E. Deming, Brooklyn, N. Y. App. filed April 4, 1894. The combination of a drawbridge having tracks and a third rail or electric conductor, different generators upon the opposite sides of the same, one being connected to the central and side rails of different tracks, and the other generator being connected to the remaining rails, and a pair of magnets placed upon each locomotive having armatures which independently control the motive power of the said locomotive and connect any circuit with the central conductor and different side rails.

589,583. ELECTRIC CUT-OUT; J. R. Hersh, Denver, Col. App. filed Jan 11, 1895. The combination of a case having conductor wires connected therewith, a disc mounted to rotate therein and having a series of fusible metallic links upon one face and a series of ratchet teeth upon the other, a lever and pawl, and means for connecting the fusible links with the conductor wires.

539,585. RHEOSTAT FACE PLATE WITH SUPPLEMENTAL RHEOSTAT; F. Kreamer and M. Kruger, Chicago, Ill. App. filed Sept. 19, 1894. A rheostat having a main switching device, and an auxiliary device controlled thereby and adapted to be intermittently brought into circuit therewith, the total amount of resistance in said auxiliary switching device being approximately equal to the amount of resistance between two contact posts of the main switching device.

539,616. ELECTRICAL BOND CLAMP; A. Green, Rochester, N. Y. App. filed Aug. 27, 1894. A rail-bond comprising a loose gib provided with a groove to fit a bond wire or rod, and provided with means for tightening it upon the rail.

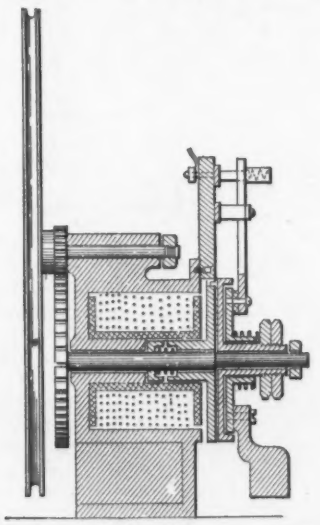
539,622. CUT-OUT FOR ARC LAMPS; P. Kirkegaard, Brooklyn, N. Y. App. filed Nov. 9, 1894. The combination of a carbon rod and a cut out lever pivoted adjacent thereto, the rod standing in the path of movement of the lever, preventing its movement, and a pin or projection at the extremity of the rod adapted to engage with the lever and swing it when the rod has moved out of the path of the lever.

539,636. TRANSMITTER DIAPHRAGM; G. A. Nellis and Florence S. Weisser, Allegheny, Pa. App. filed March 11, 1895. A transmitter diaphragm composed of aluminum with a small percentage of nickel and iron.

539,681. BASE FOR TROLLEY POLES; A. Green, Rochester, N. Y. App. filed Sept. 5, 1894. A trolley base having a base plate formed with a socket step lined with a series of rolls, a swiveling head with arbor fitted within such rolls, the head being provided with suitable tension springs adapted to engage and hold the pole in an upright position.

539,701. MULTIPLE SIGNAL TRANSMITTER; B. J. Noyes, Boston, Mass. App. filed Nov. 4, 1890. A multiple signal transmitter consisting of a units and tens group of rotatable signal wheels, a normally open signaling key for and adapted to be closed by each signal wheel, and a motor to rotate the wheels in unison, combined with a selecting device including a series of normally open contacts in electrical connection with a battery, a branch wire leading from one member of each key to a group of contacts, a single wire leading from the other member of all the keys to the battery circuit, and means for closing any one of the contacts of the selecting device, whereby the current is completed through one of the signaling keys at each revolution of the wheels.

539,712. TELEPHONE CALL; F. J. Troll, Washington, D. C. App. filed Sept. 22, 1894. The combination of a box, permanent magnets, a rotating armature arranged between the poles of the magnets, a coil spring fixed at one end of the armature shaft and directly connected to the same, a pulley attached at the other end, a metal tape wound about the pulley, and a lever connected at its inner end to the tape and extending through a slot in the box, and a pull handle attached to the end of the lever outside of the box.



No. 539,778.—Rheostat Switch for Electric Motors.

539,725. CUT-OUT BLOCK; F. A. Chapman, Philadelphia, Pa. App. filed Feb. 5, 1895. A cut-out having a plug provided on each of its two sides with two chambers insulated from each other, one of them having a contact plate connected therewith, and the other a terminal to which is attached the other end of the wire, and a tap wire, and a casing enclosing the plug.

539,737. ELECTRIC TREASURE GUARD; R. A. Habersham, Portland, Ore. App. filed Jan. 3, 1895. The combination of a counter upon which money or other valuables are handled, one or more metallic plates forming a part of the said counter, a metallic floor plate adjacent to the said counter, an electric circuit including the said counter and floor plate or plates, and capable of supplying a current of dangerous strength, and a treasure box of boxes arranged to have metallic contact, and a switch for closing the circuit.

539,778. RHEOSTAT SWITCH FOR ELECTRIC MOTORS; F. B. Rae, Detroit, Mich. App. filed July 6, 1894. The combination of a stopping and starting switch, a rheostat switch whose resistance coils are upon the field magnet and connected in series with the armature coils, the said switch having also a self-closing contact device, actuating connection, and an electric clutch to make and break connection.